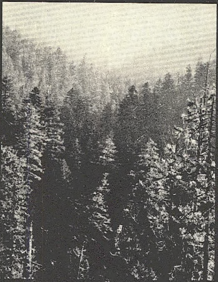

Curt Berklund
BUREAU OF LAND MANAGEMENT
DIRECTOR

FINAL

ENVIRONMENTAL IMPACT STATEMENT

PROPOSED FEDERAL COAL LEASING PROGRAM

UNITED STATES DEPARTMENT OF THE INTERIOR

FINAL

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Summary

( ) Draft, (x) Final Environmental Statement
Bureau of Land Management

1. **Type of Action:** (x) Administrative, ( ) Legislative

2. **Name of Action**: Lift moratorium and resume coal leasing by the Bureau of Land Management, utilizing the Energy Minerals Activity Recommendation System. The program involves some 85 million acres of identified coal reserves located primarily in the Northern Great Plains and northward along the continental divide from New Mexico and Arizona through Montana. Action will include existing preference right lease applications, plus future competitive sales.

3. **Summary of Environmental Impacts**: Extraction of coal from leased Federal lands creates a wide range of social, economic, and environmental impacts. Surface disturbance ranges from the extreme during surface mining to the minimal associated with a mine mouth operation. Surface mining results in temporarily drastic topographic, vegetational, and ecological alterations.

4. **Alternatives Considered:**

   A. Nationwide Energy Source Alternatives
      - Substitutability in Electric Power Generation
      - Imports
        - Oil Imports
        - Natural Gas –
          - Pipeline Natural Gas Imports
          - Liquefied Natural Gas Imports
        - Outer Continental Shelf (OCS) Production
        - Oil Shale
        - Onshore Oil and Gas
          - Crude Oil
          - Natural Gas
        - Hydroelectric Power
        - Nuclear Power
        - Geothermal Steam
        - Bituminous Sands
        - Hydrogen
        - Biological
        - Solar Energy
        - Tidal Power
        - Wind Energy

   B. Energy Conservation

   C. Leasing Alternatives
      1. Continue leasing based on pre-1971 procedures.
      2. Curtailment of future leasing and revoke existing valid rights.
      3. No new competitive leases but honor existing valid rights.
      4. Curtail future leasing and reevaluate existing leases for NEPA compliance and diligent development.
      5. Continue leasing subject solely to the Secretary's February 1973 Short Term Criteria.
      6. Short-term criteria in conjunction with honoring existing rights.
      7. Initiate an all-competitive leasing program and honor existing rights.
      8. Initiate an all-competitive leasing program and revoke all existing leases which fail to satisfy NEPA or meet diligent development requirements.

Other Modifications

Limit Leases to Non-Surface Mining Tracts

Lease Only with Federal Surface

Federal Development of Coal

5. **Official Comments on Draft Environmental Statement on Federal Coal Leasing:**

Date	Federal Comments
10/4/74	U.S. Department of Agriculture, Forest Service
6/18/74	U.S. Department of Agriculture, Soil Conservation Service
7/2/74	U.S. Department of Agriculture, Soil Conservation Service
9/18/74	U.S. Atomic Energy Commission
9/25/74	U.S. Environmental Protection Agency
9/6/74	Executive Office of the President, Council on Environmental Quality
7/1/74	U.S. Department of the Interior, Bureau of Mines
7/29/74	U.S. Department of the Interior, Bureau of Mines
9/9/74	U.S. Department of the Interior, Bureau of Outdoor Recreation
9/12/74	U.S. Department of the Interior, Bureau of Reclamation
9/9/74	U.S. Department of the Interior, Fish & Wildlife Service
9/3/74	U.S. Department of the Interior, Geological Survey
7/1/74	U.S. Department of the Interior, National Park Service
8/5/74	Tennessee Valley Authority

Date	State Comments
	Arizona
6/19/74	Office of Economic Planning & Development
7/2/74	Office of Economic Planning & Development
	California
7/2/74	Colorado River Board of California
	Colorado
8/13/74	Colorado Division of Planning
	Montana
8/21/74	Office of the Governor
	New Mexico
6/14/74	State of New Mexico Environmental Improvement Agency
	North Dakota
6/14/74	North Dakota State Planning Division
6/28/74	North Dakota State Planning Division
7/18/74	North Dakota State Planning Division

5. **Official Comments (Continued)**

Date	State Comments
	Pennsylvania
8/29/74	Department of Environmental Resources (Office of the Governor)
	Texas
6/27/74	Brazas Valley Development Council
9/10/74	Division of Planning Coordination (Office of the Governor)
6/17/74	Texas Department of Agriculture (Assistant Commissioner)
9/4/74	Texas Historical Commission
6/20/74	Texas Parks and Wildlife Department
6/21/74	Texas Water Quality Board
6/21/74	Texas Water Rights Commission
6/21/74	Texas Water Development Board
6/20/74	University of Texas at Austin, Bureau of Economic Geology
	Washington
6/22/74	Department of Natural Resources
	West Virginia
6/26/74	West Virginia Legislature Courtesy of Senator Robert C. Byrd.

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Chapter One

Description of the Proposed Action

1. Background

On February 17, 1973, the Department of the Interior announced the new coal leasing policy. The policy included both short-term and long-term actions. The short-term actions included issuing coal leases to meet specific near-term needs within all requirements of the National Environmental Policy Act. The long-term policy included:

- Development of an environmental impact statement on the Department's coal leasing program, supplementing this as necessary for appropriate impact reporting on a regional basis or for individual leases, and
- Development of a planning system to determine the size, timing, and location of future coal leases in order to meet energy needs.

Accordingly, the May 9, 1974, draft programmatic environmental impact statement was released which reflected the above leasing system issues cited by the Department in 1973.

In addition, the Department has prepared or has underway regional environmental impact statements in the Eastern Powder River coal basin of Wyoming and Northwestern Colorado. Numerous site-specific environmental impact statements have been prepared or are underway for coal related projects. These are the Kaiparowits, Huntington, Alton and Emery Projects in Utah, the Western Energy Project in Montana and the Jim Bridger Power Plant in Wyoming.

This final statement describes in significant detail the total proposed Departmental coal leasing program.

2. Proposed Federal Coal Leasing Program — A Summary

Program Objectives

Since 1973, drastic changes have occurred in the Nation's energy status. Excessive reliance upon insecure foreign energy supplies resulted in a national vulnerability that was highlighted by the oil embargo of 1973. Since the embargo, world oil prices have quadrupled, and the impact is felt throughout our economy.

In October, 1974, and again in April, 1975, the President announced a major commitment to increase development and use of our domestic energy, of which coal is our most abundant source.

The following section presents a description of the proposed Federal coal leasing program which could be initiated by the Department of the Interior if, as a result of the processes involved in the preparation of this final environmental impact statement and information available from other sources, it appears that such a course of action would be in the public interest. A detailed discussion of the program summarized here is included later in this chapter.

If implemented, the proposed program would be managed so that Federal coal resources would be offered for development only where they are needed and in the quantity necessary to make a timely and market oriented contribution to national domestic energy supplies. All such development would be conducted within the constraints of *stringent* environmental standards. Coal leasing would be conducted so as to balance the following broad Departmental objectives for mineral development:

- Assure environmental protection to the maximum extent practicable;
- Achieve orderly and timely development of Federal mineral resources; and,
- Assure the receipt of a fair return for the sale of Federal mineral resources.

Program Elements

The proposal under consideration would be a departure from historic coal leasing practices prior to 1973. It would feature competitive coal leasing based on the principles of multiple-use land management and nominations for or against leasing and development by industry and the public-at-large. Federal coal leasing would not return to a reactive mode based upon individual applications for lease. Instead, the program would be designed to lease coal in quantities required to meet energy needs consistent with acceptable environmental standards.

The major elements are:

- Whenever possible, several leases in the same region will be covered by a single environmental impact statement rather than by multiple statements. In such cases, the region covered will be determined by basin boundaries, drainage areas, areas of common reclamation problems, administrative boundaries, areas of economic interdependence, and other relevant factors. In all cases, each coal lease, prospecting permit, preference right lease application or mining plan will be analyzed to determine whether or not an EIS is warranted. An environmental analysis will be prepared prior to issuing any competitive or noncompetitive lease, prospecting permit or mining plan approval. If the analysis indicates an EIS is necessary, an EIS will be prepared unless a previous environmental impact statement has sufficiently analyzed the impacts.
- Timely development of new and existing Federal coal leases through the application of diligence requirements.
- Processing of noncompetitive coal lease applications in concert with the completion or updating of comprehensive land use plans such as BLM Management Framework Plans (noncompetitive includes pending preference right lease applications or preference right lease applications resulting from prospecting permits in force). Assignment of priority for Departmental administrative support to those regions in which coal development interest appears to be highest and rapid lease processing is in the public interest; in these areas adequate resources will be devoted to process both competitive and noncompetitive leases in an expeditious manner. If both noncompetitive and competitive leases cannot be simultaneously processed, the District Manager shall establish priority based upon other surface uses, market demand and on-going mining operational considerations.
- Offering new leases for competitive sale through the Energy Minerals Activity Recommendation System (EMARS).

- Gathering coal resource and rehabilitation potential data.

Each of these program elements is discussed below.

Existing Coal Leases

There are 533 Federal coal leases currently in existence, involving about 16 billion tons of recoverable coal reserves. Excluding leased reserves which are either uneconomic to develop or environmentally unsuitable, approximately half of the recoverable leased reserves have not been committed for future development. The Department proposes to stimulate early production on these existing leases or if the lessees have no desire to develop the leases, to encourage early abandonment of the leases. These objectives will be pursued through two approaches:

- Promulgation of diligent development and continuous operations regulations; and,
- Incorporation of advance royalty requirements at the time of lease renewal.

Diligent development regulations were published as proposed rulemaking in the *Federal Register* on December 11, 1974. These regulations require the lessee to: incorporate his lease within a logical mining unit (LMU) within two years; file an approved mining and reclamation plan with the Mining Supervisor; and, as required by regulations, terms of the lease, and the Mining Supervisor, engage in the continuous operation of the mine or mines on the lease. The lease can be terminated if the lessee does not diligently develop his lease. After review of public comments received on the proposed rulemaking described above, the Department expects to promulgate final diligent development regulations. An EIS, if warranted, will be prepared subject to NEPA prior to the promulgation of such regulations.

Advance royalty requirements – to encourage diligent development and continuous production – will be imposed on the lease at the time of lease renewal. These will include required annual production schedules and a royalty rate which will ordinarily be 8 percent but never less than 5 percent. In appropriate circumstances deviation up or down from the standard 8 percent rate may be permitted. Advance royalties will be based on an assumed schedule of production which should exhaust the leased deposit in 40 years. Advance royalties, at the production royalty rate, will commence in the sixth lease year and will rise annually in amount until they are at the full level from the tenth year onward. The lessee will pay the advance royalty or the production royalty depending upon which is greater. Advance royalty payments may be credited against royalty due for actual production of coal at a later date.

No mining will be permitted on an existing lease until any required mining and reclamation plan has been approved by the Mining Supervisor. Prior to approval of the mining and reclamation plan, the Mining Supervisor in consultation with appropriate governmental agencies and affected parties will conduct an environmental analysis of the proposed mining operation to determine what the probable environmental impacts would be from the operation and to determine what stipulations would be required in the mining and reclamation plan.

Competitive Coal Leases

If the proposed coal leasing program is undertaken, coal leases would be offered for competitive sale in areas where the coal is needed and in the quantities indicated by nominations when consistent with BLM multiple-use resource planning. All coal lease sales would be carefully analyzed to avoid unacceptable environmental impacts or unacceptable impacts on other uses resulting from development of the proposed leases. The system used to select areas to be offered for competitive coal lease sale has been termed: *Energy Minerals Activity Recommendation System* (EMARS).

Under EMARS the need for coal leasing would be determined through a nomination process wherein industry and the interested public indicate areas in which coal leases should be offered and areas which should not be offered for lease or should be offered only under special conditions.

Nominations would be evaluated for environmental and other use conflicts through the Bureau of Land Management multiple-use planning system. At several stages of the planning system, there will be opportunity for review, input and participation by other Federal agencies, state and local governments, and the general public. After nominations have been analyzed through the BLM planning system, the Department will identify tracts to be considered for leasing and a leasing schedule will be prepared.

Competitive coal leases would include diligent development requirements and advance royalty payments as previously described. Similarly, stringent environmental and rehabilitation requirements would be incorporated in the leases.

The level of lease offerings would be determined by nominations and by bidding results in competitive lease sales. Lease sales, if environmentally acceptable, would be offered so long as bids remain sufficiently high to indicate the desirability of further leasing.

A single corporate surety or personal bond will be required to cover both reclamation and contract compliance. It will be scaled to the size of the risk and will not be less than $10,000.

Competitive leases will continue to be offered on a cash bonus system payable within 30 days after the lease sale, although the Department may experiment with deferred bonus or royalty systems.

Noncompetitive Coal Leasing Applications

There are 183 applications currently on hand for preference right leases on 478,400 acres. These applications include about 12 billion tons of recoverable coal reserves. Processing of these preference right lease applications would require:

- A determination by the Geological Survey that the applicant has demonstrated that coal exists on the proposed lease area in commercial quantities;
- A technical examination of the proposed lease area by BLM to determine what environmental and land use stipulations should be incorporated within the lease if it should be issued; and,

- An environmental analysis and where appropriate an EIS covering the proposed operation by BLM to determine what environmental impacts might result from mining in the area if the lease should be issued.

Diligent development requirements and advanced royalties as described under existing coal leases would be applied to noncompetitive leases as well as to competitive leases. Stipulations to protect the environment and assure adequate rehabilitation would be included in the lease.

Prior to the approval of a mining and reclamation plan for a noncompetitive lease (and as required for existing leases), an environmental analysis, and, if necessary, an environmental impact statement, would be prepared for the proposed mining operation. The Department is reviewing its procedures and criteria for determining whether or not an operator has demonstrated that coal exists on the proposed lease area in commercial quantities. It is the intent of the Department to formally define the term "commercial quantities" through the process of issuing the proposed regulations and, after a period for public comment, to promulgate final regulations.

A single corporate surety or personal bond will be required to cover both reclamation and contract compliance. It will be scaled to the size of the risk and will not be less than $10,000.

At least for the near-term, the moratorium on issuance of new prospecting permits will be continued to gain experience with the leasing program.

Data Gathering

Data gathering efforts to support the proposed leasing program include:

- Surface and mineral ownership and coal development potential mapping by BLM;
- Coal resource classification by GS;
- Overburden and hydrologic data for determining the potential for and requirements of rehabilitation; and,
- Reserve data on areas under consideration for leasing.

Surface and mineral ownership maps based upon official BLM Land Office records are being prepared by the Department for all areas of known Federal coal resources. These maps will be of use to the Department in planning for effective coal resource management and for the public in recommending areas for lease or for special considerations.

The Geological Survey will classify lands as Known Coal Leasing Areas (KCLA's) where coal exists in quality and quantity to warrant competitive coal leasing.

The BLM is conducting a drilling program to analyze the overburden and hydrological characteristics of areas considered to have a high potential for coal leasing. Data from this program will be used for determining rehabilitation measures to be applied to mining operations on these areas. Mining operations under subsequent leases in the areas will be monitored to determine the success of rehabilitation measures. Correlation between pre-sale information and post-sale rehabilitation results in prescribing rehabilitation measures on future sales.

Regulations will be considered to permit operators to drill individually or in groups on areas which have strong potential for inclusion in plans for future competitive leasing. Results of such drilling would be provided to the Geological Survey and shared with other interested parties on an equal cost basis. This program would assist both the Department and interested potential bidders in evaluating a proposed lease sale in the area of the drilling. An EIS, if warranted, will be prepared subject to NEPA prior to the promulgation of such regulations.

Revised Regulations

Departmental leasing and operating regulations (43 CFR 23 and 30 CFR 211, respectively) applicable to coal development will be strengthened to encourage that leased coal resources will be developed with appropriate environmental safeguards and to address the applicability of state laws.

These revised regulations will be published as rulemaking and an environmental impact statement will be prepared prior to promulgation.

3. Energy Minerals Activity Recommendation System

BACKGROUND

This description of the Energy Minerals Activity Recommendation System, EMARS, is meant to be a detailed view of the proposed Federal coal leasing program as well as a portrayal of the history and status of Federal coal leasing. The proposed leasing mechanism and its surrounding assumptions – the need for domestic self-sufficiency in energy production coupled with an increased concern for the protection of the environment – constitutes a leasing system based upon expressed demands from the public and industry and a multiple use planning system for federally administered lands.

Energy Overview

Fossil fuels provide over 90 percent of the energy consumed in the United States. Currently 76 percent of this energy is provided by oil and gas, while only 18 percent is from coal. Yet coal constitutes 73 percent of the total domestic fossil-fuel energy bank while oil and natural gas combined comprise only 10 percent. Oil in shale contains 17 percent but this resource is only in the initial phases of development and makes a negligible contribution to present energy resources. This would indicate that coal, and particularly the vast, relatively low-sulfur western coal deposits will assume an increasingly important role as oil and gas reserves are depleted and longer term solutions to our energy shortages are perfected.

It is estimated that the Federal Government owns roughly 60 percent of the western coal resources. Furthermore, due to scattered ownership patterns, both surface and subsurface, which have been the result of nearly 200 years of numerous land and mineral laws, the Federal Government influences the development of nearly 80 percent of all western coal resources. Roughly half of the total coal resources in the United States are located in the western coal provinces. The Department of Interior's Bureau of Land Management and U.S. Geological Survey are charged with the management responsibilities of this vast resource. The Bureau of Land Management coal leasing program has had and will continue to have considerable effect on the development and utilization of western coal resources and the environmental consequences of any such action.

Recent international incidents threatening the security and availability of non-domestic energy supplies have led to Presidentially established goals of reduced dependency on unstable foreign imports. These goals have amplified the demand for domestic coal production and use. Coupled with this increased need for domestic coal production is an equal need to protect the quality of the environment in the Federal coal lands. This includes the necessity to conform to standards established by Federal laws and regulations. A further factor, as set out in the Mining and Minerals Policy Act, 1970, is the responsibility of the Federal Government to encourage a healthy domestic privately owned minerals industry with full protection of the environment. Therefore with these three essential prerequisites, (1) to supply national energy needs, (2) to assure protection of the environment and (3) to encourage domestic private minerals industry, the Bureau of Land Management has developed a proposed coal leasing program through established resource management techniques. It is the intent of this program to make available Federal coal reserves where the advantages of coal development outweigh the environmental detriments of those developments.

History of Coal Leasing

Past coal leasing policies of the Bureau of Land Management have been responsive to requests on a case by case basis without regard to total reserves under lease. These actions resulted in large acreages of coal being leased, especially during the period of 1965 through 1967. This reactive mode of processing lease applications has been particularly true of applications for prospecting permits and preference right leases. And, prior to 1970, leases were issued without a detailed environmental analysis of the area requested for lease. Furthermore, the relatively low capital costs of acquiring and holding many preference right leases (attained by showing commercial quantities within the land held under a prospecting permit) have resulted in many current leases being non-productive. Some of these are considered to be uneconomic under current conditions. The cost of holding most undeveloped, non-competitive leases has historically been low, in many cases amounting to an annual rental fee of \$.25-\$1.00 per acre. Currently, 33 of the 533 existing coal leases are over 40 years old and less than half of the reserves for these leases are known to be planned for future production.

Subsequent to a coal lease study by BLM in 1970,[1] the Department of the Interior halted the issuance of coal leases and prospecting permits to reassess coal leasing policies. The study showed that the acreage of coal under lease on public domain increased substantially while production from Federal leases declined from a wartime high in 1945 (Figure 1-1). Acreage under lease had increased from about 80,000 acres in 1945 to about 778,000 acres in 1970. Production during this period had declined from about 10 million tons in 1945 to 7.4 million tons in 1970. Of the total acreage under coal lease, 91 percent was within non-productive leases.

From May 1971 until February 1973, no additional coal leases were issued by the Bureau of Land Management. In February 1973, the Secretary of the Interior announced a new coal leasing policy, which included short-term leasing criteria designed to maintain existing mines or to supply reserves for production in the near future. Since that time, eight coal leases have been issued under these criteria and several more are pending final approval.

The production of western coal has begun to increase rapidly, particularly since 1970. This trend is reflected in Federal production statistics. Figure 1 compares the acres under Federal lease with annual production from Federal leaseholds. Note how rapidly production from Federal leases has increased within the last several years. During this period the acreage under lease has remained constant. The increase is due primarily to (1) increasing demand for low-sulfur coal to meet air pollution requirements, (2) increasing consumption of electrical energy with a corresponding increase in the use of coal to fuel base load electric generation plants, (3) the substitution of coal for domestic oil and gas, (4) a shift in the relative price of delivered coal-derived BTU's, and (5) the development of several leases or logical mining units into productive operations to meet the new, growing market demand.

The relative importance of coal production from Federal leases vs. State, Indian and privately owned land in the six western coal States declined steadily over the last 12 years to 1972.[2] As shown in Table 1-1 U.S. coal production increased from 1960 through 1972. then declined slightly during 1973. Coal production from western States increased sharply during the entire period 1960-1973. Actual production from Federal leases also increased over the same period; however, the percentage contribution from these public land leases of all western States production declined steadily from 1960 through 1972. Only in 1973 was this trend reversed when the Federal contribution to western coal production increased from 20 to 25 percent.

Table 1-2 provides background data on existing Federal leases. Presented is information on surface and subsurface ownership, number of leases, age distribution of leases, and production. It is interesting to note that 50 percent of existing leaseholds have been issued within the last 10 years. In fact, about 12 percent have been issued within the last 5 years. It normally requires in excess of 5 years to get a coal lease into production, so we cannot expect many of these leases to be currently producing.

In short then, the conditions which led to a near-moratorium on leasing coal — low levels of coal production from Federal leases and rapidly rising amounts of federally leased reserves — have been reversed. Currently we are facing rapidly rising Federal production and relatively constant acreage under lease.

Recent studies of recoverable coal reserves under Federal lease indicate that for various reasons full produc-

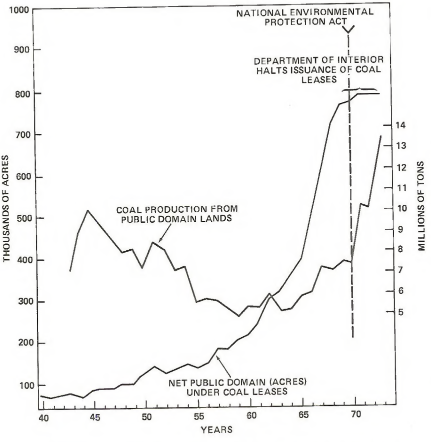


Figure 1-1. Comparison of Federal Production With Acreage Under Federal Coal Lease, 1940-1973.

[1] Holdings and Development of Federal Coal Leases, Division of Minerals, Bureau of Land Management, November 1970.

[2] Most growth in recent years in Western low-sulfur coal production has come from Indian land. Production from Indian land in 1960 amounted to 1 percent of the total production. This has expanded to about 17 percent in 1972.

Table 1-1
Production of Western and U.S. Coal Resources, 1960, 1965 1971, 1972, and 1973

	Actual				
Sector	1960	1965	1971	1972	1973
U.S. total, Million tons[1]	415.5	512.1	552.2	595.4	592
Western States, Million tons[2]	13.7	19.4	38.7	44.3	53.3
Percent	3%	3%	7%	7%	9%
Federal Land, Million tons[3]	4.2	4.9	9.1	8.8	12.9
Percent of Western States	30%	25%	23%	20%	25%

[1]Dupree, Walter, G., and James A. West, U.S. Energy Through the Year 2000. U.S. Department of the Interior, Washington, D.C., December, 1972. Bituminous Coal Facts, 1972, National Coal Association, Washington, D.C., 1973. Tonnage based on calendar year figures.

[2]The six western States included in this report, Wyoming, New Mexico, Utah, North Dakota, Montana, Colorado. Broderick, Grace N., Supply and Demand for Energy in the U.S. by States and Regions, 1960 and 1965, 1. Coal Bureau of Mines Information Circular 8401, 1969. U.S. Energy Fact Sheets By States and Regions, U.S. Department of the Interior, Washington, D.C., February, 1973. Tonnage based on Fiscal Year figures.

[3]Public Land Statistics. Bureau of Land Management, U.S. Department of the Interior, Washington, D.C., 1960, 1965, 1971, 1972, and 1973. Tonnage based on Fiscal Year figures.

tion which could be expected from these reserves in the coming years is not forthcoming.[3] Changes in regulations are now being considered which would define diligent development and continuous operations of these existing leaseholds.[4] However, some lessees will undoubtedly relinquish their leases because of their "speculative" interests rather than bring the lease or leases into production. Any person holding inventories whose prices fluctuate is to some extent a "speculator" who stands to make or lose money by buying reserves at a price different from their value when he sells them. Holding reserves off the market in anticipation of future price increases in fact has a positive social function similar to conservation – it saves resources for use later when their social value will be higher. The problem has been that in the mid-1960s too great a quantity of Federal reserves was leased, in relation to production, so that too much of the inventory profits from rising coal prices have accrued to lessees rather than to the Federal treasury. Therefore, while it is neither possible nor desirable to prevent all holdings of reserves by lessees, the new coal leasing program will discourage *excessive* reserve holdings by requiring diligent development and by charging advance royalties. These provisions will make it unattractive to lease Federal coal in amounts that are out of proportion to actual production plans.

Since the near-moratorium on coal leasing, the demand for western coal has grown and should continue to do so given the increased price of energy and the desire to rely on domestic energy sources. Pressures from industry to free western Federal coal holdings have steadily increased with the expanding market requirements for coal-derived BTU's. At the same time, several challenges to the desirability and need for vast coal development in the West have surfaced. At issue are the differences between the environmental and socio-economic impacts of large scale western coal development versus the significant contribution western coal resources could make toward reducing our dependency upon unstable imported fuels.

The Bureau of Land Management proposes a leasing system for meeting expanded Federal coal demands which is designed to meet requirements of environmental protection and mined land reclamation through the Bureau's established land use planning system. This system would prevent the return to a reactive mode of leasing in which industry demands are routinely translated into leases. The Bureau's multiple-use land management process will identify those coal areas of high development potential and rehabilitation potential and match these areas against other competing resource uses to derive a land use plan. Nominations from industry and the public, both for and against coal leasing and development, would be requested to aid in selecting proposed lease tracts within areas derived by the land use plan as suitable for coal leasing. In this manner, then, under the Bureau's proposed Federal coal leasing program, EMARS – the Energy Minerals Activity Recommendation System, BLM would select and offer federally administered coal lands for lease. Diligence requirements in the new leases would stimulate timely production. The BLM planning system, of which EMARS is a part, ensures consideration of all resource values, and the selection of lease tracts would be constrained by the systematic derivation of land use plans.

BLM Planning System

Following are discussions of the BLM land use planning system and its components and descriptions of the

[3]Holding of leases for purposes other than producing coal; leased lands which are environmentally not suited for coal development; leases in uneconomic blocks because of insufficient reserves.

[4]Proposed revisions to existing coal regulations to add definitions of a "Logical Mining Unit" and the terms "diligent development" and "continuous operations" were published in the *Federal Register* December 11, 1974 (39FR43229).

Table 1-2
Production Data from Federal Coal Leases[5]

	Acreage		No. of Present Leases	Production Tons		Age of Leases					
	Total	Private Surface		1973	Cumulative to 1972	Less Than 5 Years	5-10 Years	10-20 Years	20-30 Years	30-40 Years	Over 40 Years
California	80	0	1		1,257	1					
Wyoming*	199,950.96	117,219.84	91	4,991,059	70,017,765	15	36	28	4	4	4
New Mexico*	40,958.12	26,197.78	28	259,646	3,639,181	2	9	8	3	4	2
Oregon	5,403.18	241.09	3	80	19,138			3			
Washington	521.09	521.09 (estimate)	2	214,668	838,669	1		1			
Utah*	266,712.39	13,335.62	195	2,415,764	92,268,910	18	93	42	15	17	10
North Dakota*	16,435.75	16,435.75	18	1,535,598	24,664,824	4	5	6	2	0	3
Oklahoma	87,014.18	85,692.34	53	336,732	6,285,309	8	5	36	4	0	0
Montana*	36,232.27	35,047.54	17	1,939,914	23,034,510	1	11	3	0	1	2
Alabama	200.00	200.00	1		1,551,018		1				
Ohio	144.15		1		489,461	1					
Colorado*	122,078.14	54,606.51	113	1,746,225	37,633,241	15	42	24	13	7	11
Alaska	2,593.14	1,073.14	4	152,645	17,606,994	0	0	1	2	0	1
Totals	778,323.37	350,570.70	527	13,592,331	278,050,277	65	202	152	44	33	33

*Major coal leasing States comprise 87.9% of the total outstanding coal leases.

environmental analyses and documents which are an integral part of the planning system.

The BLM Planning System is designed to be used in the preparation and maintenance of land use plans (multiple use) for national resource land (NRL) under BLM administration. These plans, called Management Framework Plans (MFPs), establish coordination between the seven basic resource values or activities for which NRL are managed. These activities include minerals, wildlife habitat, livestock forage, watershed, timber, recreation and intensive land use (e.g., rights-of-way, urban commercial, etc). Coal is a subdivision within the minerals activity.

Management Framework Plans are prepared and maintained by staff in the 12 BLM State offices and 65 BLM districts and are being recorded for approximately 650 planning units. The system was first started in 1969 and, as of the end of FY-74, about 1/2 of the public lands under BLM management had been included in first generation plans.

The system includes a set of component parts, designed to meet specific purposes. These are described below in accordance with their function (policy guidance, information, and planning decisions).

Policy Guidance Components – Basic objectives and policies for national resource lands. Policy statements for each resource activity including a statement for energy minerals.

Information Components –

- *Resource Inventory* (Unit Resource Analyses) These are maintained for each planning unit. They include an analysis of current conditions and use and an estimate of total capability for each resource class. They also include a profile of eco-system characteristics and trends in quality. These analyses are based upon all available resource inventory data and make heavy use of U.S. Geological Survey and Bureau of Mines coal data.
- *General Social and Economic Data* (Socio-Economic Profile) These are maintained for substate regions composed of county groupings conducive to social and economic data aggregation and analysis. They include an identification and analysis of social, economic, intergovernmental and coordination issues, along with problems and trends affecting national resource lands divided into three parts: socio-economic factors; infrastructure systems; and Bureau relationships with planning use control groups, action, study and interest groups and key individuals.
- *Applied Social and Economic Data* (Planning Area Analysis) These

[5] Data current as of 1973.

analyses are prepared for planning units, or combinations of Planning Units if a Management Framework Plan is to include more than one Planning Unit. The Planning Area Analyses are organized into several major sections including: socio-economic analysis and development of regional and local demand projections for national resource lands resource products; analysis of NRL significance to the area and regional populations' cultural values, social well being, and expectations; analysis of NRL significance to a variety of infrastructures and the significance of these infrastructures to the NRL; and analysis of extent and implications of "critical environmental areas" as defined by State or Federal laws. National and regional analysis of energy requirements and alternative sources, including coal, are critical data inputs to both the Socio-Economic Profile and the Planning Area Analysis.

Public Participation – In consultation with a variety of public groups, including all those listed in the Socio-Economic Profile, the BLM planning system pulls together all public input regarding land use and resource trade-offs. BLM's objective is to ensure that all concerned and interested citizens, either individually or in organized groups, have an opportunity to fully understand the values of the national resource lands and related alternate uses, and then have an opportunity to contribute their ideas, knowledge and proposals in the planning process. This results in a wide variety of meetings and consultations, tailored to the needs of the public involved.

Planning Decision Component – (Management Framework Plan) MFPs are prepared through a three step process using all the above described policy guidance and information. They are prepared and maintained for planning units or combinations of planning units. The first step is preparation of program objectives and recommendations for each resource activity or between commodities within an activity without concern for overlap or conflict between activities. These become alternatives or options for later consideration. These must be acceptable considering social, economic, institutional and policy points of issue. Since the coal recommendation must be in terms of areas and tonnages potentially available for leasing a good perspective of the coal resource within the planning area is critical. The second step is the identification and analysis of interactions between the recommendations prepared for the seven resource activities. This includes analyzing their impact on social, economic, institutional, environmental and resource values, and the development of alternative solutions for major competitive situations. The Bureau does not have a single objective or absolute policy guide for resolving conflicts. Rather, an attempt is made for a multiple use compromise which will maximize overall public satisfaction. The third step is the review of all data by authorized decision makers (State Directors and District Managers) and explicit selection and approval of specific alternatives resulting in a clear planning decision.

The resulting planning decision for coal will indicate geographic areas planned for coal development and will identify the general stipulations and mitigating measures necessary to reasonably protect other resource values. There is no time frame specified for development or development priority established between separate areas. Back-up data will indicate potential coal areas not planned for mining and why, and the tonnages, demand data, and other rationale used to support the planning decision.

BLM Environmental Analysis System

Environmental Assessment – A great deal of environmental assessment occurs in the preparation of Management Framework Plans, as indicated above. However, there are many situations where more detailed and specific assessments are needed to consider specific alternative action proposals which are within the framework of the MFP. The environmental assessment is especially important in situations where a Management Framework Plan has not yet been prepared or where data have changed and the MFP has not yet been revised.

As a result of this evaluation, BLM has developed a system of environmental analysis having these major characteristics:

Purpose

The purpose of the environmental analysis is to identify ways to minimize adverse environmental impacts in the consideration of an action not requiring an environmental statement, and as a means for determining whether conditions are such that an environmental impact statement is needed.

Scope of Use

Environmental analyses are prepared for all proposed Bureau actions where there is potential for environmental impact and at the point in the decisionmaking process where such analysis will be most effective. Bureau guidelines identify 57 different types of actions which might require environmental analysis. A proposal to issue a mineral lease (such as for coal) is a subsection within one of these types. Last year, approximately 10,000 environmental analyses were completed by the BLM.

Content of an Environmental Analysis

The Environmental Analysis includes a standard format.

The following sections are provided:

- Descriptions of the Proposed Action and Alternatives
- Descriptions of the Environment
- Analysis of Proposed Action and Alternatives
- Environmental Impacts
  - Anticipated Impacts
  - Possible Mitigating or Enhancing Measures
  - Recommendations of Mitigating or Enhancement
  - Residual Impacts
  - Relationship between Short-term Use and Long-Term Productivity
  - Irreversible and Irretrievable Commitment of Resources
- Persons, Groups, and Organizations Consulted
- Intensity of Public Interest

- Participating Staff
- Recommendations on Environmental Statement
- Interdisciplinary Team Recommendations (optional)

Analytical Concept

The analysis is based upon first identifying and describing elements of the present environment. A standard classification structure of 10 environmental components including 55 elements is provided. An assessment is made as to the existing quality or trend of each element involved and the impact of each discrete part of the proposed action and alternatives on each element. This detailed analysis provides a basis for understanding the cumulative impact of various alternatives, finding the least environmentally damaging alternative and finding the most effective mitigating measures.

Environmental Impact Statements – BLM approaches the preparation of Environmental Statements from two program perspectives. First, from the "top down," Environmental Impact Statements are prepared for entire program areas to explore the environmental impact of existing or proposed program systems. From the "bottom up," Environmental Impact Statements are prepared where the Environmental Analysis indicates a need for a statement and this need is confirmed by management decision at the Director's level. Environmental Impact Statements are also prepared for some standard kinds of actions, such as issuing an OCS oil and gas lease or considering a major coal based energy complex including one or more coal leases, a mining plan, and sites for transmission and processing facilities. In many cases these are joint State and Federal agency efforts, with one agency designated as lead. In general, the need to prepare an Environmental Impact Statement is determined by the Director on a case by case basis by the Environmental Analysis Record.

The procedures for preparing Environmental Impact Statements are well established in the Council on Environmental Quality guidelines and Department procedures and are not discussed here.

Interagency Coordination for Environmental Analysis

Although the proposed coal leasing program will affect over 26 agencies and numerous State agencies in both coal producing and coal consuming States, the major responsibilities of land management and supervision of mining operations lie with the Bureau of Land Management and Conservation Division of the Geological Survey.

The Bureau of Land Management administers laws relating to mineral resources of all Federal lands, including lands under its primary jurisdiction, submerged land of the Outer Continental Shelf, lands withdrawn by other Federal agencies, acquired lands, and Federal mineral reserves in private lands.

In the proposed Federal coal leasing program, the BLM exercises the Secretary of the Interior's discretionary authority under the Mineral Leasing Act to determine whether or not leases, permits or licenses are to be issued. Furthermore, the BLM is responsible for issuing leases, permits and licenses and in conjunction with the Geological Survey for formulating the surface, non-mineral resource and rehabilitation requirements to be incorporated in them. Where BLM has surface management responsibilities over coal deposits, it must jointly determine with the USGS the adequacy of environmental protection and rehabilitation aspects of all mining operation plans.

In compliance examination, the BLM works in conjunction with the Geological Survey. Mineral information needed for multiple use planning, geologic, engineering, hydrologic, and economic value determinations for Federal coal leasing are all provided by the Geological Survey. Furthermore, the GS is responsible for supervision of coal mining operations on Federal lands and federally held reserves on private land. Supervision of mining operations is according to the lease terms specified in BLM issued leases.

Once tracts have been selected through the proposed coal leasing program and approved by the Secretary of the Interior, they would be offered for lease by the State Offices of the BLM. Subsequent to Secretarial approval of a lease schedule and as determined by the BLM State Office and the area mining supervisor of the Geological Survey, carefully supervised exploration drilling would be undertaken by interested parties. The resulting data would be available to the Federal Government and held confidential. Information could be shared by interested parties on a cost sharing basis until the lease is awarded. After the lease is issued all exploration data would be available to the public. Testing (drilling) regulations are being considered as an amendment to 43 CFR Subpart 3507 to provide for this supervised drilling prior to the lease sale.

After lease issuance, it is the responsibility of the Geological Survey to prepare an Environmental Impact Analysis upon the submission of detailed mining plans by the lessee. The proposed coal leasing program would require greater coordination between the Geological Survey and the BLM, particularly in the environmental planning process.

Information from various Federal, State, and local agencies affected by coal development is requested throughout the proposed coal leasing program. Integrating this information along with Federal agency information is of paramount importance in the proper functioning of the proposed Federal coal leasing program from the call for industry and public nominations to the monitoring of rehabilitation subsequent to the issuance of the lease.

The text which follows describes in detail the proposed Federal coal leasing program and its primary components.

ENERGY MINERALS ACTIVITY RECOMMENDATION SYSTEM (EMARS)

The Energy Minerals Activity Recommendation System, EMARS, is the Bureau of Land Management's proposed Federal coal leasing program. The system, designed to work within the Bureau's land use planning and programming systems, determines the location, size, timing and susceptibility to rehabilitation of future Federal coal leases. While the BLM carries final responsibility for land use decisions on public lands, other Federal, State and

local agencies provide necessary input into the early phases of EMARS and the planning system of which it is a part. Thus EMARS, through a multiple resource evaluation at the field office level, examines and evaluates data on:

- rehabilitation potential;
- the resource base (minerals, watershed, range, wildlife, forestry, recreation, etc.);
- surface and mineral ownership;
- socio-economic impacts of coal development;
- State and local government input and requirements; and
- national, regional and local demand for Federal coal derived by requests for and analyses of industry nominations and areas of public concern.

Through the land use planning system, then, areas of resolved conflict and high coal development potential are derived. Given these coal leasing areas (areas planned for coal extraction but not prioritized into best areas for initial coal leasing), a call for industry and public nominations and analysis by the BLM and USGS determine the tracts to be leased. Lease sales are arranged in accordance with leasing schedules as approved by the Secretary of the Interior.

EMARS answers the questions of where, when, how much, and at what cost and impact should the Federal Government offer coal for lease. The system approaches these questions through a comprehensive land use planning system which attempts to maximize resource values and uses, and seeks to minimize conflicts and/or the deleterious effects of certain resource development.

One of the problems of the former coal leasing program was that excessive quantities of reserves were leased in relation to actual rates of production. It is therefore important that there be a clear procedure for making sure that in the future program neither too much nor too little Federal coal is leased.

The rate of Federal leasing will necessarily be constrained by three major factors:

- Especially for the first year or two, the capacity of the BLM and USGS staffs to do necessary environmental and resource analysis, and Management Framework Planning, will limit how much leasing can be done. Over the longer run, of course, this need not be a constraint if it seems advisable to devote more Federal staff resources to the planning process.
- The terms of the leases offered will also be a limiting factor. With diligence requirements and advance royalties, in particular, many leases which would otherwise have attracted purchasers will not do so. This of course is the purpose of these provisions -- to limit leasing to those lessees who intend to develop the deposit promptly.
- Finally, the market for coal, and the costs of producing it, will limit (or stimulate) industry interest and willingness to acquire leases, as the expected profitability of doing so rises or falls.

Taking into account these constraints, the rate of Federal leasing that is in the public interest will be determined by following these major leasing policies:

- Leasing will not take place where environmental damages would be unacceptable. Making this determination is the purpose of the BLM system of environmental analysis and Management Framework Planning.
- Leasing will be permitted only in amounts that are appropriate in relation to plans to produce the coal in the near future. The diligence requirements and advance royalties to be included in future leases are intended to insure this.
- Should the moratorium on prospecting permits be lifted, in limited areas where the presence or workability of coal is not known, and where mining would be environmentally acceptable if coal were found, prospecting permits may be issued. These permits, under the terms of present law would ripen into leases if coal in commercial quantities were discovered. Such leases, however, could be subjected to the same environmental and diligence requirements, and the same form of advance royalties, as leases sold competitively.
- Under the environmental and diligence restrictions described above, Federal coal will be leased if an offer is made that is equal to or exceeds the estimated resource value of the deposit.

By following these general policies, Federal leasing will be responsive to the best evidence of the need for Federal coal, namely the market demand for it. But coal will not be leased simply to add excessively to reserves, nor will it be leased where careful environmental analysis indicates it should not be. The actual rate of leasing that will result, in acres or tons per year, will vary, depending primarily on variations in the net value of the coal as influenced by fluctuations in its price and cost of production. If competition is heavy for leases offered, and bids are high, the rate of offerings will be increased; if few leases are sold and bids per ton are low, the rate of offerings will be reduced. this amounts to controlling price

But regardless of rational policies designed to optimize the rate of future Federal coal leasing, it is argued that Federal coal leases currently on hand suggest that further leasing may be unnecessary. However, such a no leasing policy would fail to recognize that:

- because of changing economic conditions (transportation, population, regional demand for electricity, mining costs, etc.), it is probable that much of the coal now under lease is no longer suitable for development, and that Federal coal not yet leased in some areas will be the lowest cost source of supply;
- diligence requirements extended to existing leases will bring production or relinquishment over a period of a few years;
- additional leasing may be required to avoid unneeded increases in energy costs;
- some leased areas may be environmentally unsuitable for development and, recognizing this, additional leasing in acceptable areas may substitute for these unsuitable areas, decrease the relative value of the environmentally unsuitable areas, and bring about relinquishment;
- considerable interest in obtaining Federal coal lands is forming among firms not now holding Federal coal leases indicating that companies willing and able to produce coal

should be granted a less restricted avenue to acquiring Federal coal lands.

Objectives

More generally, the proposed long-term coal leasing program must balance the Department's three overriding goals:

1. Assure environmental protection to the maximum extent practicable,
2. Provide for orderly and timely resource development, and
3. Assure a fair market value return for resources sold.

Environmental Protection – The first Department goal, to assure environmental protection, is stressed throughout the leasing system, beginning with a comprehensive analysis of all resource values. Subsequent stages of the BLM land use planning system involve minimizing or mitigating the impacts of resource development, in this case coal, by eliminating areas which cannot be rehabilitated or which offer other, overriding resource values. Public meetings throughout the planning process offer avenues of communication and critical review by all interested parties. Even though areas may have been identified by the land use plan as being tentatively suitable for leasing and mineral development, the USGS and BLM further insure protection of these areas by designing rehabilitation standards, compliance guidelines, lease stipulations on development, and bonding requirements. In addition, as the BLM District Manager selects proposed tracts for leasing, environmental analyses are prepared which include the alternative tracts. These Environmental Analysis Records (EAR), as previously described, provide a comprehensive view of the environmental considerations associated with the proposed tracts, and may also require that a more thorough documentation of environmental impacts be prepared in the form of an Environmental Impact Statement.

Orderly and Timely Development – The second overriding goal requires that the BLM proposed leasing system provide for orderly and timely resource development. The BLM planning system, discussed previously, provides for the orderly development of coal resources on public lands through a comprehensive analysis of all resources, their relative values, and the associated environmental considerations. EMARS meets the requirement of timeliness in its early identification of high development potential coal areas, where industry interest is high, where public concern is low, and where the BLM land use plan (Management Framework Plan) has indicated the areas as suitable for mining.

Fair Market Value – The Department's third overriding goal, to assure fair market value return for resources sold, is accomplished through the establishment of rentals, royalties, and competitive bonus bids. Rentals are nominal holding costs in consideration of the land use. The addition of royalties returns to the government a fair share of the value of the resource.

Bonus bids reflect the accessibility and value of the resource, provide an avenue for the expression of competitive interest, and adjust the total prior determinations of rental and royalty to fit the fair market value at that point in time. The Geological Survey recommends rental, royalty, and minimum bonus bid levels to the Bureau of Land Management.

In short, the Energy Minerals Activity Recommendation System is designed to obtain the following benefits:

1. provide an acceptable system for leasing Federal coal with minimum environmental impacts;
2. remove any unnecessary barriers to the development of Federal coal;
3. increase supplies of low sulfur western coal; and
4. decrease the need for importation of oil and gas.

The following summary sheet and flow charts portray the three phases of EMARS and their associated data inputs and operational components. The text following the flow diagrams describes in greater detail the nominations and programming phase, the scheduling phase, and the leasing phase of the proposed Federal coal leasing program, EMARS.

Nominations and Programming Phase

The first two phases of EMARS, the nominations and programming phase and the scheduling phase, are developed concurrently and are continuous in nature. The nominations and programming phase provides overview and guidance functions primarily through centralized data inputs, overview documents such as an Environmental Impact Statement, policy guidance from the President and the Department, and programming for adequate manpower to implement the system. The scheduling phase can be equated to the BLM planning system with emphasis on land use planning for coal resources. The planning system is a continuous process, and the derived land use plans are dynamic in that changing conditions eventually require land use plans to be re-cycled. The scheduling phase develops in a decentralized manner with the BLM District Offices carrying the responsibility for deriving the land use plans. A leasing schedule is the end product of the aggregated land use decisions of the scheduling phase.

Nominations –
Industry Nominations and Areas of Public Concern – The first phase of EMARS involves the call for and joint analysis of industry nominations and areas of public concern. The initial call for nominations (first year), to be published in the *Federal Register*, is designed to provide BLM with data on where and how much coal to lease. Based upon these nominations, BLM will assign to the field sufficient technical staff to prepare land use plans, environmental analyses, resolve or mitigate resource conflicts, and hold lease sales if found to be compatible with the environment. In the first year of the proposed coal leasing program, the BLM will proceed with EMARS utilizing current staff levels and land use planning which has been completed. The initial nominations will guide the BLM District Managers in their selection of proposed tracts for leasing in those areas identified by the land use plan as being most suitable for coal leasing. These first nominations for coal lease areas and areas of public concern will also be used to identify areas of high industry interest

EMARS Flow Chart Definition of Terms

BLM	Bureau of Land Management
BM	Bureau of Mines
FEA	Federal Energy Administration
GS	U.S. Geological Survey
WO	BLM Washington Office (Headquarters)
DSC	BLM Denver Service Center
SO	BLM State Office (SO-State Director)
DO	BLM District Office (DM-District Manager)
EAR	Environmental Analysis Record
EIS	Environmental Impact Statement
Rehab. Stds.	Rehabilitation Standards
Compl. Guides	Compliance Guidelines
Stips.	Stipulations
KCLA	Known Coal Leasing Area
URA	Unit Resource Analysis
MFP	Management Framework Plan
PAWP	Pre Annual Work Plan (budgetary submission)
AWP	Annual Work Plan (BLM fiscal year objectives)
AS/E&M	Assistant Secretary-Energy and Minerals
AS/PD&B	Assistant Secretary-Program Development and Budget

ENERGY MINERALS ACTIVITY RECOMMENDATION SYSTEM

Coal Ownership and Resource Data Industry Nominations Areas of Public Concern Program Planning and Budgeting	NOMINATIONS AND PROGRAMMING PHASE
Mineral Resource Inventory Coal Development Potential (GS–BLM) Mineral Activity Recommendation Environmental Analysis Resource Trade-Offs and Land Use Decision Nomination Requests in Coal Leasing Areas State Office Tract Selection Proposals Preparation and Approval of Leasing Schedule	SCHEDULING PHASE
Final State Office Selection of Tracts EIS Preparation Pre-Sale Evaluation Lease Sale, Evaluation and Issuance GS Operational Monitoring BLM Compliance Management Rehabilitation Monitoring	LEASING PHASE

Proposed Federal Coal Leasing Program
Bureau of Land Management

where BLM planning efforts have not been concentrated to date in order that future years' effort may be directed toward these areas.

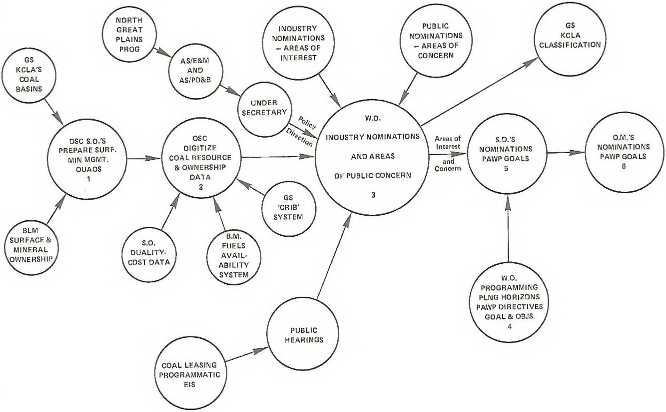
Proposed plans call for nomination requests to industry and the public on an annual basis beginning in 1975. Industry and the public will be requested to nominate specific areas for Federal coal leasing and areas of concern.

Nominations will be accepted for any area, inside or outside of Known Coal Leasing Areas, and will be described in legal description terms of township-range identification. The number of nominations for and against leasing will not be limited. However, for administrative purposes in determining an accurate representation of intensity of interest (both positive and negative), the size of any one nomination will be limited to 2560 acres. Nominations may be as small as 40 acres, smaller if ownership patterns preclude at least 40 acres. Again for ease of handling, nominations will be requested in multiples of 40 acres. While there is no limit on the number or total acreage of nominations per State, the call for nominations will require nominations to be placed in priority order for each State. The Bureau of Land Management resources of manpower and funding will be concentrated in those areas where nominations for leasing are most intense or of highest priority and where priorities of nominations against Federal leasing are not overriding. Highest priority listings of nominations for and against Federal coal leasing will be marked priority 1, with other priorities noted as 2 through (n) where (n) equals the number of nominations per State. For each nomination against leasing, specific reasons why leasing should not occur must be submitted. These data will be utilized by BLM resource managers to surface or further explicate factors which may preclude leasing and coal development within that area.

The results of completed BLM land use plans (Management Framework Plans) are on public file at the various BLM District Offices. These completed plans and their coal leasing areas identified as suitable for leasing will aid the selection and prioritization of nomina-

EMARS

NOMINATIONS AND PROGRAMMING PHASE



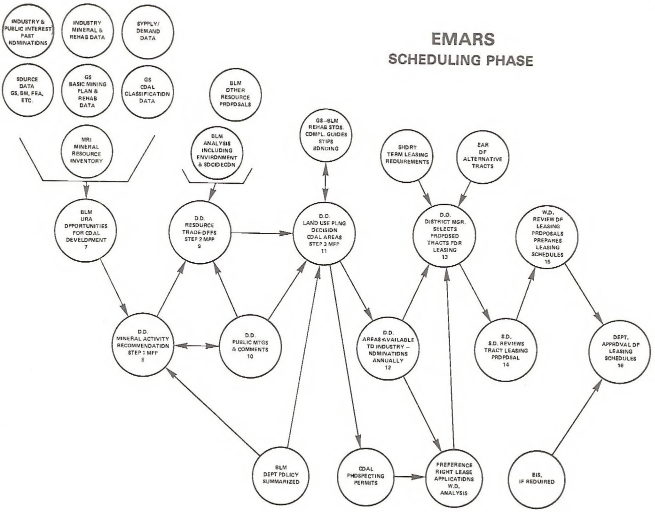
tions for and against leasing. As previously noted, the first lease sales will be held in areas with completed land use plans. Therefore, nominations for and against coal leasing within coal leasing areas will have the most effect in influencing the selection by the BLM District Manager of proposed tracts for leasing. Nominations outside of coal leasing areas will be used to guide the Bureau in its planning efforts in future years.

Ownership Maps: Minerals Management Mapping Program – Prior to the proposed resumption of Federal coal leasing and concurrent with the acceleration of other energy and non-energy mineral activity on Federal lands, the Bureau must complete quality graphic representations of surface and mineral ownership patterns. The Energy Minerals Activity Recommendation System, as the Bureau's proposed Federal coal leasing program and the leasing, location and sale of other minerals requires the delimiting of ownership as the first step in any proposed BLM mineral action. These maps, Surface/Minerals Management Quads, are now being prepared for the six western coal States in order to definitively and consistently describe the Federal mineral estate. Minerals ownership is being overprinted on the traditional color quad depicting surface ownership. Plans are being made to provide map coverage of areas of mineral interest in all States containing Federal lands.

First priority coverage, completed by the end of 1974, consisted of 100 Surface/Minerals Management Quads (over 100,000 square miles) in Known Coal Leasing Areas (KCLAs) as classified by the USGS. The second priority provides quad construction for other significant coal deposits, about 150 maps to be completed around mid 1975. Coverage of other energy minerals areas, including oil and gas, uranium, geothermal and lesser coal deposits, make up the third priority areas – to be published by mid year 1976.

These mineral ownership maps will be available to industry and the public-at-large to aid in the nomination of BLM administered mineral estate for Federal coal leasing and to identify areas of public concern.

Resource Data – Base data on all resources including coal is collected in the Unit Resource Analysis (URA) process of the Bureau's planning system. This process is the first step in scheduling phase of EMARS. The URA data is synthesized with socio-economic data, other resource program proposals, and environmental considerations into land use plans. These public documents as well as surface and mineral estate ownership maps (Surface-Minerals Management



Quads) are available as data sources for individuals, companies, and organizations wishing to nominate areas of public concern or leasing potential. Industry nominations and areas of public concern will be compiled and analyzed by the Bureau of Land Management.

The minerals portion of the planning system relies to a great extent upon the expertise of the U.S. Geological Survey, Bureau of Mines, and State geological agencies. It is the responsibility of the USGS to provide BLM with the geologic, engineering, and economic minerals data required to make multiple use land management decisions.

The Conservation and Geologic Divisions of the Geological Survey provide BLM with coal classification data, maps, and tabular data which quantify the characteristics of the coal resources. Conservation Division classifies Federal lands for mineral content. The Known Coal Leasing Area classification soon will have been applied to over 10 million acres of prime western coal land. Leasing under EMARS is not restricted to these Known Coal Leasing Areas (KBLAs), but it is expected that most areas of high industry interest will be classified as KCLA before any resumption of competitive leasing. Nominations from industry and the public received outside of KCLAs will alert the USGS to the need for evaluating areas for coal content which had not previously been classified.

The Geological Survey conducts drilling and mapping programs in addition to its classification work. These basic data collection programs are guided by the needs of BLM in the arranging of USGS priorities.

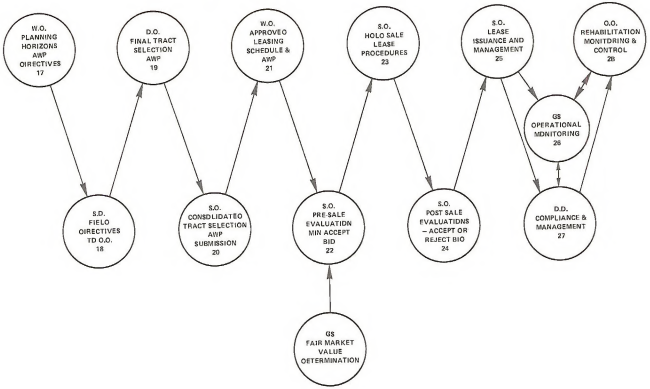
This coal resource data, derived and compiled by the USGS, will be refined by BLM staff for land use decision purposes and merged with the aforementioned surface and subsurface ownership data. The resultant data file will serve to supply valuable information to the BLM resource managers. For example, within the next several years, after full deployment of a coal resource/ownership data file, questions like the following may be asked and answered by graphic and tabular computer printout:

- A legal description of land areas in Campbell County, Wyoming, where both surface and mineral estate administered by BLM contain coalbeds 100 feet thick to a depth of no more than 400 feet, with a subbituminous rank of less than one percent sulfur content.

Developmental projects on data retrieval such as this are currently in progress in North Dakota by the BLM. Several years' effort and better coal resource data will be required, however, to implement a system of this sophistication.

EMARS

LEASING PHASE



Federal, State, and Local Government Input – With a growing concern for statewide, county and municipal impacts resultant from a Federal coal program, and with a need to integrate all available geologic and environmental data into the BLM planning system, close coordination with appropriate Federal, State, county and municipal agencies will be maintained. This coordination occurs in many phases of the proposed coal program – in the preparation of environmental and resource inventories, at public meetings, in the analysis of industry and public nominations, and in monitoring rehabilitation projects and activities of rehabilitation potential, research on rehabilitation methods, and surveillance of rehabilitation operations. The new Federal coal program is designed to avoid unnecessary duplication between State, county, municipal, and Federal legislation by incorporating all information directly into the decisionmaking process of the Bureau planning system. This positive approach coordinates State and local agencies into selecting environmentally satisfactory sites and allows for adequate rehabilitation stipulations to be contained within the lease itself.

The complex nature of land and mineral ownership patterns in the West often shows up in State lands interspersed with Federal lands. Federal land development, including leasing of National Forest, may impact this land, and vice versa. Furthermore, in order to acquire a contiguous reserve block and to make the most efficient use of the coal resource, it may be necessary to develop State and Federal land contemporaneously. To assure adequate planning, environmental protection, and resource use, particularly at the tract selection phase of the new coal leasing program, it is of paramount importance that State (e.g., Montana Bureau of Mines and Geology, Wyoming Geological Survey) and Federal agencies (e.g., BLM, USGS, Bureau of Mines, Forest Service) maintain close coordination between their programs.

Working agreements will continue to be arranged between Federal agencies to augment the proposed resumption of Federal coal leasing. For example, a drilling agreement between the BLM and USGS to become effective in early 1975 is designed to provide drill hole data on coal resources to BLM in areas identified by both agencies as being of high development potential. Draft agreements between the USGS and BLM are being reviewed which, when signed, will formalize and assign specific responsibility for the various phases of tract selection for proposed coal lease sites. In addition, the BLM has provided Conservation Division of the Geological Survey with a priority ranking by State of areas which have a high

degree of industry interest but which are lacking sufficient geologic information to make land use decisions.

Cooperative agreements between State agencies or the Governor's Office and the BLM will be arranged by BLM State Offices with concurrence from the Director, BLM. Local government working relationships with the Bureau concerning proposed coal leasing will be initiated at the District Office level of BLM with agreements approved at the BLM State Office level.

The establishment of working relationships and formal agreements between Federal, State and local Governmental units regarding resource data collection, assimilation, and analysis and environmental safeguards is an important part of the overview function of the nominations and programming phase of EMARS.

Scheduling Phase

As the nominations and programming phase provides guidance functions from coal resource and ownership input, nominations, and analysis of budgetary requirements, the scheduling phase of EMARS carries the decisionmaking process to the field offices of the Bureau of Land Management. At the District Office level, the Bureau's planning system derives land use plans and, from these decisions, proposed tracts for coal leasing. The end product of this phase is a Federal coal leasing schedule approved by the Secretary of the Interior.

State and Local Government Involvement and Public Participation – In the scheduling phase of the EMARS program, full public and State and local Government participation will be requested and encouraged. This participation will be at each level of the multiple land use planning process, with participation varying from informal to formal inputs. In following the BLM planning system, there are steps in the land use planning system (development of Management Framework Plans) where more specific participation is encouraged. BLM District Offices are always open to public inquiry and comments on land use planning. Other informal contacts include previously mentioned working relationships between local municipal Governments and the BLM field office staff. More formal input from the public and concerned groups is requested through public meetings on proposed BLM land use actions. At these public meetings all information available to the public that would be pertinent to the resource itself should be made available to the BLM as well as any information that will relate to the impact, conflict or support between other resource uses that occur in the area including environmental and socioeconomic considerations. Following the development of Mineral Activity Recommendations in the planning system, public meetings are scheduled for more intensive public input in the evaluation of the recommended resource use mix. Participation will be open to the general public with invitation or public notice designed to encourage all interested citizens and industry representatives, either individually, or in organized groups to participate. This forum furnishes them an opportunity to understand the values of the public lands and related alternate uses and an opportunity to contribute additional knowledge, ideas, and proposals in the planning process. In addition to public and industry input, an integral part of scheduling phase of EMARS will be the presentation of tentative land use decisions to local and State governmental units for their critical review. The District Manager of BLM weighs these public, industry and State and local government comments heavily in his final determinations of land use patterns. With guidance from the BLM Director, the State Directors review the land use patterns as developed by the District Offices.

State and local Government inputs in terms of planning for coal leasing and development are critical, given the socioeconomic, environmental, and political ramifications of increased coal development. Western lands and their unique checkerboard patterns of surface and mineral ownership, due to railroad land grants and the Homestead Act, require continuous communications among BLM, State, and local Governments.

Resource Data –

Unit Resource Analysis and Minerals Inventory – Land use management decisions, which include leasing of coal on public lands, must be made with access to the most complete data base possible. Minerals resource data are to be gathered and consolidated through many sources with the Geological Survey being a primary source. The procedure for gathering and consolidating this data is included in the BLM planning process identified as a Unit Resource Analysis (refer to I.C.–BLM Planning System). In developing the basic Unit Resource Analysis (URA) data for coal leasing, the following items comprise the basic inputs:

1. *Industry and Public Interest*
   Calls for nominations constitute the primary source of public and industry interest data in the proposed Federal coal leasing program. Annual nominations will be a source of dynamic input for identification of current interest. Initial and continuing formal and informal expressions of interest in areas through direct contact with industry and environmental representatives will be recorded.
2. *Source Data*
   Federal agencies such as the Federal Energy Administration, Bureau of Mines, Geological Survey and Bureau of Reclamation prepare data applicable to the coal resource in national, regional and local situations. Literature searches will be conducted and pertinent base data extracted or referenced for inclusion in the Unit Resource Analysis.
3. *Industry Mineral and Rehabilitation Data*
   Industry information beneficial to the data base will be gathered through efforts of the BLM and Geological Survey in cooperation with Industry. Protection of proprietary information will be assured.
4. *Basic Mining Plan and Rehabilitation Data*
   The Geological Survey furnishes data on mining plans and rehabilitation needs that may be anticipated for the area based on prior experience in the coal basin, private land mining operations, adjoining existing operations, and technical experience.

5. *Coal Classification Data*
   The Geological Survey will furnish data consisting of maps and narratives defining the areal extent of coal, coal quality, water content, seam thickness, ash content, BTU's and other data as available for the area being considered.
6. *Supply-Demand Data*
   Projections of energy supply and demand developed in documents such as the Project Independence Blueprint and others will be considered for general evidence of requirements for the resource development.
7. *Mineral Resource Inventory*
   A series of mineral resource inventories prepared by BLM for systematic inventorying and economic evaluation of mineral resources on the public lands will be developed. The inventories consist of a general mineral resource analysis, indicated mineral areas, comprehensive analysis of mineral factors, identification of mineral resource areas and classes of deposits, and a mineral resource inventory library.
8. *Energy Minerals Rehabilitation Inventory and Analysis (EMRIA)*
   EMRIA, a rehabilitation data collection and analysis program, includes analysis of soils, surface and ground water, mining problems associated with rehabilitation, and socioeconomic problems associated with mined land reclamation. The program is jointly funded by the BLM, USGS and Bureau of Reclamation to determine rehabilitation potential of select coal lands under consideration for development.

The Unit Resource Analysis requires an analysis of the current situation and includes such data as the current mineral status of the coal resource, information from the minerals resource inventory and other sources that are consolidated to include chemical and physical factors, technologic feasibility factors, geologic work maps, leasable mineral and water classification maps, and statistical spread sheets of coal resource data.

In addition, inclusion in the URA of graphics and narratives describing opportunities for coal development (the next step of the URA process) requires the preparation of coal resource base maps (USGS) and a physical profile including climate, topography, hydrology, vegetation, soils and geology.

Coal Development Potential – The USGS provides the geologic, engineering and economic data describing coal resources required for BLM decisions regarding multiple use land management. In providing this coal resource information, the Geological Survey prepares three primary products for the Bureau of Land Management's multiple use planning system.

- Leasable Mineral and Water Power Classification Map – Indicates leasable mineral land classifications such as Known Coal Leasing Areas (KCLAs), Known Geothermal Resource Areas (KGRAs), Known Geologic Structures (KGS), etc., and categories of water power.
- Coal Resource Map – A published map and narrative describing in detail the quality, extent, thickness, and depth of coal deposits.
- Coal Development Feasibility Overlay – A transparent overlay to the Coal Resource Map which summarizes USGS recommendations for coal development (underground, strippable, and in-situ) considering such factors as engineering and mining economic feasibility, near-term technologic feasibility, logical mining units, existing mines and supply contracts; graduates coal resources into three categories of coal development feasibility – high, moderate, and low.

All of these formal inputs from the USGS into EMARS will be prepared at scales and map formats consistent with BLM's Surface/Minerals Management Quads (surface and mineral ownership).

The last phase in the BLM Unit Resource Analysis (inventory of resources) for the coal resource incorporates the recommendations of the Survey's Coal Development Feasibility Overlay and results in the BLM prepared Coal Development Potential Map. This CDP map, as it is termed, further graduates the USGS recommendations by considering such additional factors as availability or near-term availability of water for industrial development, proximity to existing or planned roads and rail lines, surface and mineral ownership patterns, climatic conditions favorable to mining, etc. These additional factors refining USGS recommendations of coal development feasibility account for usage in the Mineral Activity Recommendations of BLM's land use planning system. The Bureau's categories are similar to the USGS generalized recommendations of coal development feasibility. BLM gradations are (1) high, (2) moderate, and (3) low coal development potential, and two other levels (4) prospectively valuable, and (5) insufficient data.

In general, the lowest extraction cost, high development potential coal in a BLM planning unit will be placed in category 1, and thus have the highest priority in the Mineral Activity Recommendation.

It may be that no category 1 (high coal development potential) or category 2 (moderate coal development potential) areas exist within a given planning unit. In such a case the CDP map would show just the lower categories of coal.

The preparation of Coal Development Potential Maps and narratives describing the coal resource potential are the final products of the mineral portion of the URA process as it relates to the coal resources.

Mineral Activity Recommendation – The Coal Development Potential maps with broad classifications based on the five development potential categories become the basis for recommendations for the first step of the Management Framework Plan (final land use plan). This level of information is useful in identifying other general resource-use conflicts. The Coal Development Potential Map identifies in broad areas the relative likelihood of coal development.

The maps also provide a mechanism for the assessment of the impact of other resource development on the coal resource. This is especially important where large capital investments are contemplated for surface resource

development in coal category 1 and 2 areas.

The Minerals Activity Recommendation (MAR) containing the most highly recommended areas of coal development potential is the end result of these planning procedures which view only the coal resource and its potential. The MAR will be submitted for multiple-use review and evaluation with other resources in the next step of the BLM planning system – resource conflict resolution.

The Mineral Activity Recommendation conflicts with other resource uses are identified. Where necessary, the recommendations for coal in the land use overview are modified to accommodate overriding resource conflicts.

Resource Use Conflicts – Activity recommendations for minerals within the Bureau's planning system are developed as a single program recommendation for all minerals found within a particular planning unit. The highest development potential coal areas are recommended as one segment of this overall minerals program recommendation. Activity recommendations are developed for each resource. These recommendations are considered in total for all resources along with socioeconomic needs and interagency commitments identified. All identifiable overlaps and conflicts are considered and a set of multiple use recommendations are prepared for the desirable resource mix based on consideration of all factors including national and Departmental goals of environmental protection and timely development of mineral resources.

Land Use Decision –

Departmental and Bureau Policy – Guidance and direction for evaluating the relationship of resources in national programs may be found in Departmental and Bureau Regulations, Manuals and Instruction Memoranda. The recommendations made following consideration of all resource uses and policy guidance are submitted to the appropriate line office (State Director or District Manager) responsible for the decision. These decisions, when completed, documented and approved by the line office, become the Management Framework Plan (final land use plan) and constitute the direction for development of the Minerals Activity Recommendations and all other resource programs for management and development.

Results – These are areas that have been identified through the Management Framework Plan where all of the resource management programs have been considered and resource use conflicts have been resolved or found to be of minimum impact. The desirability of leasing in these coal areas would be greatest from both resource and environmental standpoints. Recommended leasing in these areas assures the most rapid action on lease sale proposals because of the limited conflicts that require resolution prior to a lease sale. These coal leasing areas are available for inspection at BLM District Offices as part of the land use plan.

Prospecting Permits – Issuance of prospecting permits will be considered in areas where there is inadequate coal resource information. A critical review of these permit applications relative to multiple use and environmental conflicts will be made. The selection of "coal prospecting areas" will become part of the land use plan and be based on a selection of areas classified as subject to prospecting by the Geological Survey.

Coal Lease Nominations and Procedures – After the initial call for nominations (first year), requests for industry nominations and areas of public concern will be published annually. Ownership maps printed for the western coal lands will allow industry and the public to select their nominations, both for and against coal leasing. Nominations will be called for in priority order for each coal State and nominations are to be described by township-range identification. Nominations will be accepted both within and outside of Known Coal Leasing Areas (KCLAs) as classified by the USGS. Each BLM District Office will place on public file, prior to the call for nominations, a graphic and narrative description of coal leasing areas as derived through the Management Framework Plan. These land use plans, although dynamic in nature, should guide industry and the public in the selection of their priority areas for or against Federal coal leasing. Nominations will be accepted outside these coal leasing zones, but further study on these areas of incomplete multiple use planning requires that coal leasing areas will be considered first in any leasing schedule.

Applications for coal leases will continue to be accepted and will be reviewed annually and considered as nominations for coal leasing. The emphasis will remain, however, with competitive Federal coal leasing primarily in KCLAs, in coal leasing areas (as derived through the Bureau's multiple use planning system) of proven industry interest and high development and rehabilitation potential on a BLM initiated basis.

Tract Selection –

Selection of Proposed Tracts – Given the completed land use plan and an analysis of industry interest and areas of public concern within coal leasing areas, the BLM District Manager will select proposed tracts for coal leasing in conjunction with the Conservation Division of the USGS. The emphasis in selection centers around strong industry interest areas where conflicts as a result of coal leasing are minimal or where they have been overridden given the greater value of the coal resource. The District Manager will propose coal lease tracts with an identified and documented high development and rehabilitation potential. Thus, leasing will take place only where land use plans are completed, where the land use plans provide for coal development, and where nominations or other indicators of demand request the leasing.

Priorities for BLM District Offices in processing lands for coal leasing are:

- Preference Right Lease Applications, and
- Bureau-motion (BLM initiated) leasing through EMARS.

Pending Preference Right Lease Applications (see following section) will be processed expeditiously. Concurrent with the processing of Preference Right Lease Applications will be the completion of land use plans in coal resource areas. Given the constraint of manpower limitations in the USGS and BLM, the second priority workload at the District level for coal land actions will be the selection of coal lease tracts through the Bureau's pro-

posed Federal coal leasing program, EMARS.

Preference Right Leasing – A preference right lease application may be filed on public land where a permitee has discovered coal in commercial quantities while operating under a valid prospecting permit. The prospecting permit is obtained for two years initially with 2 year extension permitted on lands where the Government has little knowledge about the existence or workability of the resource.

In 1971 the Secretary of the Interior ordered a near-moratorium on coal leasing. Since that time there have been applications for preference right leases but only two have been issued. Prior to 1971, 272 preference right coal leases were granted or approximately 52 percent of the outstanding leases. There have been 183 preference right lease applications submitted totaling 496,000 acres. This acreage includes about 12 billion tons of coal.

Criticisms of past coal leasing policy, particularly with respect to preference right leasing, have led BLM to conclude that, while there is a valid need for some prospecting mechanism, the automatic issuance of a permit (and of a lease upon discovery of coal in commercial quantities) offers little credence or protection to the environment. Environmental problems may be exposed as knowledge of subsurface data is acquired through exploration. Thus, the issuance of prospecting permits will follow the following criteria:

1. that the existence or workability of the coal is not known;
2. that an overview of the rehabilitation potential has indicated that rehabilitation is feasible and practical;
3. that other resource uses do not override the possible extraction of coal; and
4. that a need exists for the development of coal in a particular area or for a particular quality of coal.

Even with the controlled issuance of prospecting permits, however, the emphasis will remain upon leasing competitively in areas where coal resource data are available. To ensure this emphasis on competitive classification of coal lands, the Geological Survey will be requested to give immediate consideration for classification of lands upon recommendation by BLM.

EAR – Proposed Tracts – After the selection of proposed tracts for leasing by BLM field offices, Environmental Analysis Records (EARs) are prepared on the various tract proposals. These analyses assimilate all available environmental base line data on the area in question. The EAR is designed to yield a comprehensive overview of the environmental suitability of an area for leasing. The EAR also recommends whether an Environmental Impact Statement is required.

Preparation and Approval of Leasing Schedule – After BLM District Offices prepare tentative lease schedules for their areas of management, public meetings may be held, as circumstances warrant. The meetings will provide local opportunities for industry and public advice in developing schedules to be submitted to the State Offices.

BLM State Offices review and analyze coal leasing proposals submitted by the districts. The proposed tracts are consolidated into a State leasing schedule and forwarded to the BLM headquarters office in Washington.

The Washington Office review and analysis consolidates State leasing schedules and prepares a BLM coal leasing schedule for the coming year. BLM State Offices will retain the responsibility for holding coal lease sales within their State. Sales may be scheduled as often as four times a year for each State.

This schedule, along with the supporting data, is sent to the Office of the Secretary of the Interior for concurrence.

Final Tract Selection

Final Tract Selection – With concurrence of a final coal leasing schedule by the Secretary, instructions are forwarded to the BLM State Offices from the BLM headquarters with approved lease tracts for each State. The directives to the field consist of objectives and specific tasks to be completed along with the assignment of sufficient manpower and dollars to complete the objectives. Upon receipt of the final State leasing schedules, the BLM State Offices instruct the appropriate District Offices to prepare for the coal lease sales.

Lease Procedures – The first prelease step encompasses the "technical examination" (43 CFR 23) as prepared by the BLM. The technical examination assesses the impact of proposed exploration or mining operations on existing or potential resource management programs or land uses. It allows the BLM decisionmaker to prepare written general requirements consistent with the Management Framework Plan for a future lease or permit so that a potential operator is fully aware of all BLM land use restrictions or reclamation requirements for the specific site. Based upon these requirements, the operator can then prepare an exploration or mining plan (including rehabilitation proposals), which the administering agency can subsequently check for compliance and approval.

Pre-sale Evaluation – Geological Survey conducts a pre-sale evaluation of all tracts of Federal coal lands offered for competitive leasing. All pertinent geologic, engineering and economic data are used by the multidisciplinary evaluation team responsible for each tract.

Lease Announcement – The announcement of the lease offering must include all the terms and conditions of the leases to be issued. The terms and conditions are derived from the Mineral Leasing Act as amended and the regulations in Titles 30 CFR 211, 43 CFG 23, 43 CFR 3500 and will also include special stipulations for reducing or eliminating environmental hazard or damage (including rehabilitation requirements) derived from the environmental analysis or impact statement.

Lease Sale – In accordance with existing regulations 43 CFR 3500, the Mineral Leasing Act as amended, and Departmental and Bureau directives, orders and policies and delegations of authority, the State Director, for the State wherein the lands to be offered are located, is responsible for holding the competitive lease offering or the issuance of Preference Right Leases as the case may be.

Post-Sale Evaluation – A post-sale review of the bids as to their acceptability in reference to their mineral

value is conducted by BLM in consultation with Geological Survey utilizing their technical data and information. BLM then determines the acceptability of the bids.

Lease Issuance and Management –

State Office Lease Issuance – Based on the recommendation of the post-sale evaluation and completion of the necessary adjudicative process including qualifications and bonding determinations, and preparation of lease forms including all necessary terms, conditions and stipulations, leases will issue pursuant to existing Departmental and Bureau policy, regualtions 43 CFR 3500 and directives.

District Office Compliance and Management – Pursuant to existing delegations of authority, regulations in 43 CFR 23 and 43 CFR 3500 and consistent with the terms, conditions and stipulations of the lease, Bureau policies and procedures, the District Manager is responsible for the implementation and coordination of the total resource management program, including supervision of rehabilitation operations on the public lands embraced in mineral leases. In particular, with respect to mineral leases, compliance with surface disturbance stipulations are monitored on the area of operations, in concert with USGS as defined in Secretarial Order 2948, a working agreement between BLM and USGS.

USGS Operational Supervision – The Geological Survey is responsible for the regulation of all coal exploration and development on public lands. This includes assuring safety of operations, protection of the environment, efficient development of coal leases and collection of royalties.

Summary

Policies of the mid-1960s which led to the leasing of Federal coal lands with subsequent holding of excessive reserves or marginal production by lessees are now considered inadequate. Recently evolved environmental ethics, and the realization of the energy crisis in the U.S., bring us to a new era and new philosophies regarding the leasing of Federal coal lands. Renewal of leasing to satisfy the goal of orderly and timely development of our mineral resources to meet national needs must be consistent with the requirements of environmental protection and sound land use management.

The proposed Federal coal leasing program, the Energy Minerals Activity Recommendation System – EMARS, seeks to define the extent to which Federal coal can help to satisfy domestic energy needs, and includes a land use planning system for leasing federally administered coal to fulfill these energy demands. Through an established multiple-use planning process, all resource values are accounted for, thus providing for protection of the environment and, at the same time, assuring an adequate supply of Federal coal.

In summary, the Energy Minerals Activity Recommendation System consists of three phases:

1. *Nominations and Programming*
   An overview function designed to gather and analyze coal resource and ownership data, call for public and industry nominations for and against Federal coal leasing, and assign sufficient manpower to carry out multiple land use objectives and meet Federal coal demands;

2. *Scheduling*
   The land use planning process established by the Bureau of Land Management to define the various resources, resolve resource conflicts, minimize or mitigate environmental degradation, derive a land use plan, select proposed lease tracts from coal leasing areas, and prepare a leasing schedule; and

3. *Leasing*
   The formal mechanism within the BLM for assigning field office objectives, determining minimum bids for coal lease sales, holding lease sales, and evaluating lease bids.

4.
The National Energy Picture And The Role Of Coal

HISTORY

The first coal mining in America began in Virginia in 1787. The earliest record of production was in 1820 when 3,000 tons of coal were produced. Production of a million tons of anthracite was reached in 1837 and the same tonnage for bituminous coal in 1850 (E.S. Moore, 1922), coal production reached the 100 million ton level in 1880. It exceeded the 200 million ton rate by the turn of the century (Bureau of Mines, 1920). The gradual growth of coal production increased to 579 million tons in 1918. Production remained somewhat steady until the depression years when it dropped to a low of 310 million tons in 1932. The industry operated at a deficit during the 1930s. The alltime peak production year was 1947 when 631 million tons of coal were produced. This peak was achieved just three years after the railroads began changing from coal to diesel fuel in 1944. Transportation, both railroads and ships, at that time were using 132 million tons of coal annually.

Coal production was sporadic from 1947 to 1961. It dropped to a low of 392 million tons in 1954, up to 500 million tons in 1956 and back down to 403 million tons in 1961. From 1961 to 1974, there was a steady growth with the exception of a minor drop in 1968, caused by strikes.

A major effect upon coal production from 1947 to 1961 was the steadily increasing availability of oil and gas. The convenience of use, competitive price, and new technology of the oil and gas industry resulted in its increasing role in meeting the energy requirements of the country. Coal's contribution to the total U.S. energy demand dropped from 43.5% in 1947 to 19% in 1974 (Bureau of Mines).

Table 1-3
Production of Bituminous and Lignite Coal, by Type of Mines
Thousands of Short Tons

Year	Strip Mining	Auger Mining	Underground Mining	Total Production
1900	–	–	212,316	212,316
1905	–	–	315,063	315,062
1910	–	–	417,111	417,111
1915	2,832	–	439,792	442,624
1920	8,860	–	559,807	568,667
1925	16,871	–	503,182	520,053
1930	19,842	–	447,684	467,526
1935	23,647	–	348,726	372,373
1940	43,167	–	417,604	460,772
1945	109,987	–	467,630	577,617
1950	123,467	–	392,844	516,411
1955	115,093	6,075	343,465	464,633
1960	122,630	7,994	284,888	415,512
1965	165,241	14,186	332,661	512,088
1970	244,117	20,027	338,788	602,932
1973	276,645	15,739	299,353	591,738
1974	311,530	15,670	273,800	601,000

Source: U.S. Bureau of Mines

The transportation market for coal has virtually disappeared. Household and commercial space heating have drastically declined. But there has been a tremendous growth in coal consumption for the electric utilities.

Table 1-3, production of bituminous coal, by type of mine, relates the production of coal from 1900 to 1974. It also breaks down the mining methods which include strip, auger, and underground mining (Bureau of Mines, 1974).

The first production figures for strip mining were in 1915 when less than 1 precent of the nation's total coal was mined by stripping. By 1930,

stripping accounted for 5 percent of coal mined. This figure rose to 10 percent in 1940; 20 percent in 1950; 30 percent in 1960; 35 percent in 1969; and approximately 50 percent in 1974 (Bureau of Mines, 1974).

Outlook

The future demand for coal has been projected by many people, but the Department of the Interior projections were the most widely used. The West and Dupree report "United States Energy Through the Year 2000" projected coal demand to the year 2000 for the Department of the Interior, Table 1-4.

Table 1-4
Production of Western and U.S. Coal Resources, 1960, 1965, 1971, and 1972, with Projections to the Year 2000

	Actual				Projected		
Sector	1960	1965	1971	1972	1980	1985	2000
U.S., total[1]							
Million tons	415.5	512.1	552.2	595.4	740.0	980.0	1,418.0
Western States[2]							
Million tons	14.0	19.4	42.1	48.0	130.0[3]		
Percent	3%	4%	8%	8%	18%		
Federal Land[4]							
Million tons	5.4	5.9	10.1	10.2	43.0[5]		
Percent	39%	30%	24%	21%	35%		

[1] Dupree, Walter, G., and James A. West, *U.S. Energy Through the Year 2000.* U.S. Department of the Interior, Washington, D.C., December, 1972. *Bituminous Coal Facts, 1972*, National Coal Association, Washington, D.C., 1973.
[2] Western States, including North Dakota and South Dakota, excluding Alaska. Broderick, Grace N., *Supply and Demand for Energy in the U.S. by States and Regions, 1960 and 1965,1. Coal*. Bureau of Mines Information Circular 8401, 1969. *U.S. Energy Fact Sheets by States and Regions*, U.S. Department of the Interior, Washington, D.C., February, 1973.
[3] North Dakota lignite is estimated at 14.3 million tons, included in total. Robert R. Nathan Associates, Inc. *The Potential Market for Far Western Coal and Lignite*, Volume I Report to the Office of Coal Research, U.S. Department of the Interior, Washington, D.C., December, 1965. *The Potential Market for Midwestern and Alaskan Coal and Lignite*. Report to the Office of Coal Research, U.S. Department of the Interior, Washington, D.C., August, 1966.
[4] *Public Land Statistics*, Bureau of Land Management, U.S. Department of the Interior, Washington, D.C., 1960, 1965, 1971, and 1972.
[5] Known expansion commitments to 1980 of existing federal lease holders as of 1972. Indian land with 34.3 million tons in 1980 is not included in this total. Also excluded are contracts on the private land portion of federal leaseholding tracts totaling 48.0 million tons in 1980.

Since the above projection has been made, a different situation has occurred. The energy shortage has come into being, resulting in much more governmental participation in energy allocation and development.

In March of 1974 Project Independence was initiated to evaluate the Nation's energy problems and provide a framework for developing a national energy policy. As a result of this effort, the Administration set the goal of the doubling of coal production by 1985 to a level of 1.2 billion tons annually.

In order to determine a national energy policy, the Energy Reorganization Act of October 11, 1974 established the Energy Resources Council in November 1974, chaired by Rogers C.B. Morton, Secretary of the Interior. The Energy Resources Council is composed of the Secretaries of State and Interior, the Administrators of the Energy Research and Development Administration (ERDA) and the Federal Energy Administration, the Director of the Office of Management and Budget, and other members designated by the President. In addition the act established the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission.

Although major policy will emerge from the Energy Resources Council, Project Independence Blueprint Report supplies an in-depth analysis that places the Nation's energy alternatives and their impacts in perspective. This was undertaken to focus public debate on the real issues and choices facing the American people.

An outline of a few points made about coal in the Project Independence Blueprint Report would include the assumptions under Business As Usual (BAU): normal expansion of business activity would call for increased coal supply – of 5.4 percent a year from 1972 through 1980, and 3.8 percent a year from 1980 through 1990. It was also assumed that pre-embargo public land leasing practices would be continued and that mining capacity would not expand significantly in the earlier years because of the long lead times required for mine development equipment and related requirements. Furthermore, BAU would assume phased implementation of the Clean Air Act with the installation of effective stack gas control equipment, and moderate strip mining legislation.

Production levels under Accelerated Development (AD) conditions were set high to create an energy scenario that would not be constrained by available supply under even the most optimistic demand projection. It was also assumed that air pollution control regulations and oil prices would have no major adverse impacts on coal demand. Moreover, it was assumed that additional public lands would be leased, as needed, for new mines and expansion of existing mines; and synthetic fuels production would grow rapidly, beginning in 1980. The AD scenario calls for a 19 percent increase of supply per year from 1973-1980 and a 10 percent increase per year between 1980 and 1990.

The coal industry has the capacity to satisfy almost any foreseeable demand for coal by 1985, at prices near

1973-1974 levels and considerably below the inflated spot market levels of 1974, assuming no equipment, manpower, demand constraints or excessive governmental constraints. To the extent that investment decisions will have to be made in the immediate future to achieve long-range production goals, a sufficient return on investment and resolution of major uncertainties including public land coal leasing policy will be needed. Since unconstrained maximum production levels could be very high, BAU and AD scenarios were developed so that demand and resource constraints are the only limit to supply. Under BAU and certainly under AD, production potential exceeds most estimates of demand. Coal production could be over 2 billion tons per year in 1985 under these assumptions although the above constraints could keep production to about 1 billion tons in 1985. Large increases could occur in Appalachia undergound and Northern Great Plains surface mining. All supply curves are relatively flat at reasonably low prices. Regional supply curves for coal are very different as shown in the P.I.B.

Drawing from the above findings, coal can play an increasing role in the domestic energy picture, reaching maximum national production levels of from 1-2 billion tons a year by 1985 based on various assumptions. The minimum 1 billion tons of coal production includes the assumption of some expanded coal supply and accelerated development assumes proportionately more expanded coal supply.

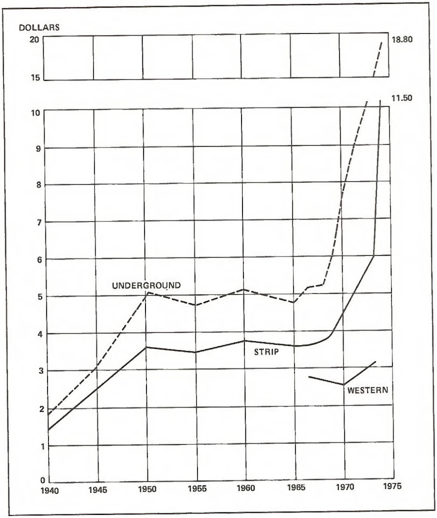


Figure 1-2. Average Price per ton, F.O.B. Mines of Underground and Strip Mined Coal in the United States, 1940-1974, and Average Price Western States of Montana, New Mexico, North Dakota, and Wyoming, 1967-1973.

Western Coal

In recent years increased attention has been focused on the development of coal in the western States. Presently western coal represents only a small share of U.S. production, but western coal accounts for a substantial share of the overall growth in the coal industry. It contributed one-third of the national growth since 1965. It is expected to contribute one-half of U.S. growth to 1980.

The main attraction of western coal is seen in the cost differential in developing western coal and in its lower sulfur contents. Price trends suggest that the most efficient and lowest cost sources of energy in the U.S. will be western coal.

In recent years, the comparative advantage of western coal, already substantial, increased even more. From 1969 to 1973, Montana coal prices rose from \$2.10 to only \$2.80 per ton, while Illinois coal in contrast increased from \$4.30 to \$6.70, Pennsylvania coal increased from \$5.90 to \$10.30, and West Virginia coal increased from \$5.70 to \$11.60. The differential advantage increased from 1969 to 1973 and continued to rise in 1974.

Figure 1-2 shows the comparative advantage of 1) strip mined coal relative to deep mined coal, and 2) western strip mined coal relative to the U.S. average strip mined coal. The average surface mine price F.O.B. mine was average for the U.S.; 3) economies of scale with larger mine size potential and lower unit costs, \$3.78 total cost for an average western mine and \$7.42 per ton for an average eastern mine; 4) lower external cost per ton of land reclamation, for the average seam thickness in the East of five and one-half feet would cost \$0.06 per ton to generate \$500 per acre and \$0.26 per ton for \$2000 per acre. For the average western coalbed thickness of 25 feet it would take \$0.06/ton to generate \$2000 per acre and \$0.26 per ton would generate \$10,000 reclamation funds per acre.[1]

The West has an advantage with respect to social costs too, as can be demonstrated for land rehabilitation

Table 1-5
Effect of Changes in the Thickness of Coal Seams on the Amount of Reclamation Funds Generated Per Mine Acre

		Cost in Dollars Per Ton of Coal Mined ($/ton)											
		Reclamation Funds Generated Per Mined Acre											
Thickness of Coal (feet)	Estimated Recovery Per Acre (tons)	$500	$1,000	$1,500	$2,000	$2,500	$3,000	$4,000	$5,000	$10,000	$20,000	$30,000	$50,000
3	4,590	.1089	.2179	.3268	.4357								
4	6,120	.0817	.1634	.2451	.3268								
5	7,650	.0654	.1307	.1961	.2614								
10	15,300	.0327	.0654	.0980	.1307	.1634							
15	22,950	.0218	.0436	.0654	.0871	.1089	.1307	.1743					
20	30,600	.0163	.0327	.0490	.0654	.0817	.0980	.1307	.1634				
25	38,250	.0131	.0261	.0392	.0523	.0654	.0784	.1046	.1307	.2614			
30	45,900	.0109	.0218	.0327	.0436	.0546	.0654	.0871	.1089	.2178			
40	61,200	.0082	.0163	.0245	.0327	.0408	.0490	.0654	.0816	.1634			
50	76,500	.0065	.0131	.0196	.0261	.0327	.0392	.0523	.0654	.1307	.2614		
75	114,750	.0044	.0087	.0131	.0174	.0217	.0261	.0349	.0436	.0871	.1743		
100	153,000	.0033	.0065	.0098	.0131	.0163	.0196	.0261	.0327	.0654	.1307	.1961	
150	229,500	.0022	.0044	.0065	.0087	.0109	.0131	.0174	.0218	.0436	.0871	.1307	.2179
200	306,000	.0016	.0033	.0049	.0065	.0082	.0098	.0131	.0163	.0327	.0654	.0980	.1634

Assumptions: Heating value of coal – 8,000 Btu per pound
Recovery factor of coal – 90%
Specific gravity of coal – 1.25 (1700 tons/acre-foot)

Walsh, Richard G., "Some Benefits and Cost of Strip Mining Western Coal Resources," Great Plains Agricultural Council Pub. No. 65, April 1974.

after strip mining of a site is completed. Western strip mining would disturb around one-third as many acres per million tons of annual output as in the East, and would generate 4 times more dollars per acre for land rehabilitation.[2] Costs of land leveling in the West have ranged from $100 to $500 per acre. Some estimates are as low as a few cents per ton of coal mined (*Southwest Energy Study*, 1972). Much of the debate over the availability of funds for land rehabilitation may be stilled by a careful application of Table 1-5 which shows the effects of changes in the thickness of coal seams on the amount of reclamation funds generated per mine acre.

The largest disadvantage to development of western coal is social costs. Strip mining causes social costs of soil erosion potential due to removal of vegetation and exposure of soil preceding reclamation phase, loss of other land uses until reclamation is achieved, and loss of wildlife habitat. However, these impacts will be highly localized being only in the area of an existing operation. An increase of mining activity regardless of the managing method may cause social costs such as increasing the burden on existing municipalities and their facilities and changing local lifestyles. In some circumstances because of the location of an operation many of these costs such as the burden on facilities and changes in lifestyle may not occur. Also, these impacts are on a smaller scale per ton output than would be so in the eastern or central part of the United States.

In summary, western coal will be a prime target for future energy development. The basic driving mechanism for this will be economics. Western coal is cheaper in some respects to eastern and central coal and is rapidly becoming cheaper than other forms of energy.

Federal Coal

Federal coal until recently has not been a major part of overall coal supply. Federal production has been approximately 1 percent of total production. Federal ownership of the coal resource in the West is approximately 60 percent but because of ownership patterns, Federal policy influences upwards of 80 percent of western coal. Federal coal is, therefore, inseparably tied to overall western coal development.

The relative importance of coal production from Federal leases vs. State, Indian and privately owned land in the six western coal States declined steadily over the last 12 years to 1972.[3] As shown in Table 1-6, U.S. coal production increased from 1960 through 1972, then declined slightly during 1973. Coal production from western States increased sharply during the entire period 1960-1973. Actual production from Federal leases also increased over the same period; however, the percentage contribution from these public land leases of all

[1]Some Benefits and Costs of Strip Mining Western Coal Resources, Richard G. Walsh, Great Plains Agricultural Council, Pub. No. 65, April 1974.

[2]Cost Analysis of Model Mines for Strip Mining of Coal in the U.S., BOM IC-8535, U.S. Dept. Interior, Wash., D.C., 1972.

[3]Most growth in recent years in western low-sulfur coal production has come from Indian land. Production from Indian land in 1960 amounted to one percent of the total production. This has expanded to about 17 percent in 1972.

western State production declined steadily from 1960 through 1972. Only in 1973 was this trend reversed when the Federal contribution to western coal production increased from 20 percent to 25 percent.

The increase in overall western coal production is due primarily to (1) increasing demand for low-sulfur coal to meet air pollution requirements, (2) increasing consumption of electrical energy with a corresponding increase in the use of coal to fuel base load electrical generation plants, (3) the substitution of coal for domestic oil and gas, and (4) a shift in the relative price of delivered coal-derived BTUs.

Future of Federal Coal

In determining coal production potential the P.I.B. analysis provides a regional base to determine Federal Coal production potential. It is a crucial assumption of P.I.B. that nuclear energy production will expand very rapidly, and displace what would otherwise be coal-fired electric generation. If this optimistic prediction is too high, more coal than the 1.1 billion tons in the table will be produced, probably in the 1.1-1.5 billion ton range.

P.I.B. suggests that Rocky Mountain plus Northern Great Plains coal production will be 200-300 million tons in 1985. In 1973, Federal coal production was about 12.9 million tons (25 percent) of the combined Rocky Mountain and Northern Great Plains Regions. This would suggest that the share of Federal production in the West will probably rise by 1985, since 80% of the local lands are owned or influenced by the U.S. Government.

Assuming the Federal share of total Western production remained at 25 percent, Federal production would be 50-75 million tons per year by 1985; if it rose to 50 percent, Federal production would be 200-250 million tons per year. Federal production in the upper range of 100-150 million tons per year by 1985 is more likely because (1) Federal share in the West is likely to increase, and (2) P.I.B. assumptions on nuclear energy contributions may be optimistic, (3) the higher the price of oil and gas, the more coal will be demanded, (4) Federal air quality regulations since 1971 have required new stationary emission sources to emit no greater than 1.2 pounds of sulfur dioxide (SO_2) per million BTU's of heat input to the combustion process. In addition, State laws in 36 States require adherence to this standard.

Table 1-6
Production of Western and U.S. Coal Resources, 1960, 1965, 1971, 1972, and 1973

			Actual		
Sector	1960	1965	1971	1972	1973
U.S. total,					
Million tons[1]	415.5	512.1	552.2	595.4	592
Western States,					
Million tons[2]	13.7	19.4	38.7	44.3	53.3
Percent	3%	3%	7%	7%	9%
Federal Land,					
Million tons[3]	4.2	4.9	9.1	8.8	12.9
Percent of Western States	30%	25%	23%	20%	25%

[1] Dupree, Walter G., and James A. West, U.S. Energy Through the Year 2000. U.S. Department of the Interior, Washington, D.C., December, 1957. Bituminous Coal Facts, 1972, National Coal Association, Washington, D.C., 1973. Tonnage based on calendar year figures.

[2] The six western States included in this report, Wyoming, New Mexico, Utah, North Dakota, Montana, Colorado. Broderick, Grace N., Supply and Demand for Energy in the U.S. by States and Regions, 1960 and 1965, 1. Coal Bureau of Mines Information Circular 8401, 1969. U.S. Energy Fact Sheets by States and Regions, U.S. Department of the Interior, Washington, D.C., February, 1973. Tonnage based on Fiscal Year figures.

[3] Public Land Statistics. Bureau of Land Management, U.S. Department of the Interior, Washington, D.C., 1960, 1965, 1971, 1972, and 1973. Tonnage based on Fiscal Year figures for the six western States.

5. Historical/Physical Context

HISTORY OF FEDERAL COAL LEASING

Early Legislation

Coal has been the subject of special legislation, beyond the scope of the general mineral location laws of 1866, 1870, and 1872. Because of its vegetative origin, coal was not classed as a mineral by the Land Department until Congressional legislation declared it to be such.

Before 1864, coal lands were disposed of under settlement and other laws. However, the General Preemption Act passed in 1841 contained a provision that "no lands on which are situated any known salines or mines shall be liable to entry under and by virtue of the provisions of this act." Congress, on July 1, 1864, assuming that coal land had been excluded from the Preemption Act of 1841, passed legislation providing for the preemption of coal lands in legal subdivisions, at a minimum price of $20 per acre to the highest bidder at public sale. Legislation enacted March 3, 1865 modified the acreage and payment provisions of the 1864 statute to give a preemption right to 160 acres of coal land to a person and 320 acres to an association upon payment of not less than $10 per acre where the lands lay more than 15 miles from a railroad, and $20 per acre where the lands lay within 15 miles thereof. Finally, in 1873, Congress enacted what may be called the "Coal Lands Act," which, with its amendments, governed the disposal of coal deposits on the public domain until the passage of the Mineral Leasing Act of 1920.

The 1873 act reenacted the acreage and payment provisions of the Act of March 3, 1865; but added the provision that when any association of not less than four persons had expended $5,000 in working and improving any mines located within the limits thereby established, they might make an additional entry on 640 acres at the appropriate limit price.

The Coal Lands Act of 1873 was merely an extension of the legislation of 1864 and 1865. Coal quickly acquired value with the extension of the railroads into the west.

One of the chief objectives of the Act of 1873, with its restrictions as to the quantity of coal lands which could be acquired by a single purchaser or association of purchasers, was to prevent monopolies in coal lands on the public domain, an objective fully respected by the courts.

The Coal Lands Act of 1873 provided two procedures by which coal lands might be acquired. The first was by the application of a duly qualified person or association to the register of the proper land office, and payment for the lands in the sum of $10 per acre if situated more than 15 miles from a railroad or $20 if more closely situated. The maximum acreage permitted to an individual was 160 acres and to a group of individuals 320 acres. An entry under this section has been declared to be a sale, with no elements of preemption.

The second procedure was the same as the first, except that a preference right-of-entry was granted to a person or association of persons who had opened and improved coal mines upon the public lands and were at the time of the application in actual possession; and, if consisting of a group of four or more persons who had expended at least $5,000 in work and improvements, might enter up to 640 acres. The practical differences between the two proceeding sections would appear to be that, under the second procedure, the entrant would have to prove the known character of the land as coal land.

Section One of the Coal Lands Act of 1873 gave a right-of-entry by legal subdivisions the requirement that entry of legal subdivisions resulted in the interpretation that the act had no application to unsurveyed coal lands on the public domain.

The Coal Lands Act of 1873 embraced the public lands in the states of the West, together with the public domain in Arkansas, Florida, Louisiana, Mississippi, and parts of Oklahoma. Legislation of 1900 and in 1904, extended the coverage of the act to Alaska, but the act had little or no practical operation there.

The Supreme Court of the United States decided early, in *Colorado Coal and Iron Co. vs. United States,* that the Act of 1873 removed from the operation of the General Preemption Act of 1841 and from the later homestead law only those lands upon which were situated "known coal mines" coal.

In 1906 at the request of President Theodore Roosevelt, the Secretary of Interior withdrew from all forms of entry and patent under the non-mineral land laws (i.e., Homestead Act, Desert land entry, etc.) those lands where workable coal was known

to occur. Between July 26, 1906 and November 12, 1906, 66 million acres of land was withdrawn in the states of Colorado, North Dakota, Montana, Oregon, Washington, Utah, Wyoming and the territories of New Mexico and Alaska. By 1908, 38 million acres of this withdrawal were restored to Public Domain status.

The Coal Lands Act of 1873 was amended by the Act of March 3, 1909 to permit a person who in good faith had entered upon and was proving up his claim as required by the non-mineral land laws to shift his claim to lands not withdrawn for coal reserves or receive a patent for the lands with title to the coal remaining with the federal government. This was the first law which didn't give the patentee the coal ownership.

In 1910, Congress provided that unreserved lands of the United States, exclusive of Alaska, already withdrawn or classified as coal lands, or valuable for coal, could be entered under the homestead laws by actual settlers, or under the desert-land act, with a view of obtaining or passing title, with a reservation to the United States of the coal in such lands.

Legislation in 1912 provided that, subject to reservation of the coal deposits to the United States, unreserved public lands, exclusive of those in Alaska, withdrawn or classified as coal lands might either be (1) selected by the several states under grants theretofore made by Congress of lands within their borders, or (2) sold, in the discretion of the Secretary of the Interior, under the laws providing for the sale of isolated or disconnected tracts of public lands.

Other legislation enacted in 1912 provided: "Unreserved public lands containing coal deposits in the State of Alabama which on April 23, 1912 were being withheld from homestead entry could be entered under the homestead laws of the United States."

The Stock Raising Homestead Act of December 29, 1916, reserved all the coal and other minerals to the United States. Under Section 9 of the act it is provided that one who has acquired the right from the United States to prospect or mine the coal or other minerals may reenter and occupy so much of the surface of the land as reasonably required to remove the coal. The exercising of the right, the person may do one of three conditions (1) obtain written consent or waiver of the surface owner, (2) payment of the damages to crops or other improvements to the owner under an agreement, or (3) in lieu of either of above upon execution of a good and sufficient bond to the United States for the use and benefit of the owner of the land, to secure payment of crop damages or tangible improvements of the owner.

In the last condition, the bond is not less than $1,000, or an amount mutually acceptable to the surface owner and mineral operator or as determined by a court of competent jurisdictions.

Many millions of acres of coal land in the coal states have been patented under this act, with the coal reserved to the United States.

Authority to dispose of coal deposits reserved in patents issued under the foregoing legislation actually was not given the Secretary of the Interior until 1917, and then only in accordance with the coal land laws in force at the time of such disposition.

Enactment of the Mineral Leasing Act of 1920 provided for the disposal of coal lands by leasing rather than by entry and sale. The Coal Lands Act of 1873 ceased to control the future disposition of coal lands. This was true both as to coal deposits within unoccupied public lands, and as to those deposits reserved to the United States.

Section 2 through 8 of the Act of February 25, 1920, authorize the Secretary of the Interior to (1) divide coal lands and coal deposits owned by the United States into leasing units and award leases thereon, (2) issue permits to prospect unclaimed and undeveloped areas of coal lands and coal deposits, and (3) issue limited licenses or permits to prospect for, mine, and take for use coal from public lands. Where lands included in a permit, lease, or license have been disposed of with a reservation of coal deposits, a permittee, lessee, or licensee must make full compliance with the law under which such reservation was made. Where any part of the lands embraced in an application for a coal lease, permit, or license is within a withdrawal that does not preclude disposition of the coal deposits, the head of the Government agency having jurisdiction over the lands will be called upon for a report as to whether there is any objection to the granting of a coal lease, permit, or license.

In awarding leases for coal lands improved and occupied or claimed in good faith before February 25, 1920, the Secretary of the Interior is authorized to consider and recognize the equitable rights of such occupants or claimants. The issuance of competitive coal leases and prospecting permits is entirely discretionary with the Secretary of the Interior.

Coal Prospecting Permits

Where prospecting or exploratory work is necessary to determine the existence or workability of coal deposits in an area, the Secretary of the Interior is authorized to issue prospecting permits for a term of two years. The permit entitles the permittee to the exclusive right to prospect for coal on the land described therein. A rental of $.25 per year per acre is required for a coal prospecting permit and the application therefore must be accompanied by a $10 filing fee.

A coal prospecting permit may be extended for a period of two years if the authorized official of the Interior Department finds that the permittee has been unable, with the exercise of reasonable diligence, to determine the existence or workability of coal deposits in the area covered in the permit. Such a coal prospecting permit is a prerequisite to the issuance of a preference-right lease.

Limited Coal Licenses

Section 8 of the Mineral Leasing Act of 1920 authorized the Secretary of the Interior, under such rules and regulations as he may describe, to issue limited licenses or permits for a period of two years to individuals or associations of individuals to prospect for, mine, and take for their use, but not for barter or sale, coal in the public lands without payment of rent

or royalty. Such licenses or permits may also be issued to municipalities to mine and dispose of coal, without profit, to their residents for household use.

Preference Right Leases

30 USC 201(b) provides that a holder of a coal prospecting permit who shows, before the expiration of his permit, that the land included in the permit contains coal in commercial quantities, shall be entitled to a preference right lease for all or part of the land, the area to be taken in a reasonably compact form.

Competitive Leases

Section 2 of the Mineral Leasing Act of 1920, authorizes the Secretary of the Interior, upon the petition of any qualified applicant, to divide any of the coal lands or the deposits of coal owned by the United States into leasing tracts of 40 acres each, or multiples thereof, in such form as, in his opinion, will permit the most economical mining of the coal in such tracts. Thereafter, the Secretary, in his discretion, upon the request of any qualified applicant or on his own motion may offer such lands or deposits of coal for lease, awarding such leases by competitive bidding or by such other methods as he may be general regulations adopt. These leasing tracts or units may be established either as a result of an application or when it is deemed advisable by the Interior Department that additional coal units be established.

Section 7 of the Mineral Leasing Act of 1920 provides that the royalty for the privilege of mining or extracting coal in lands covered by the lease shall be fixed in advance of the lease offer; this same section also prescribes an annual rental payable at the date of such lease and annually thereafter, at such rate as may be fixed by the Secretary of the Interior.

Modifications and Leasing of Additional Lands or Coal Deposits

Under Section 3 of the Act, a lessee may secure a modification of his lease to include contiguous coal lands or deposits if the authorized officer determines that such will be to the advantage of the lessee and the United States.

Under Section 4 of the Act, when the lessee shows that all the workable coal in a tract covered by the lease will be removed within 3 years, an additional tract of land or coal may be leased. If such tract is found to constitute an acceptable leasing unit it will be offered for leasing as provided in 43 CFR subpart 3520. If the applicant is the successful bidder and the tract can be practicably operated with the applicant's lease-hold as a single mine or unit the tract may be included in a modified lease.

History of Coal Leasing in Alaska

In 1900, the coal-land laws were extended to Alaska, but since the 1873 Coal Act contemplated sales in governmental subdivisions, the act could have no practical effect because the territory remained largely unsurveyed. To remedy this, a 1904 statute extended coal locations to unsurveyed land in Alaska, the locations to be set off in rectangular tracts containing 40, 80, or 160 acres "with north and south boundary lines run according to the true meridian" and described with reference to natural or permanent artificial monuments.

A 1908 Act provided that persons locating coal lands before November 12, 1906, might consolidate their locations by including in a single claim not more than 2,560 contiguous acres of coal land. Apparently, no patents were issued under the 1908 Act. The result was that no coal lands were developed in Alaska from the date of the general withdrawal order on November 12, 1906, until 1914. At that time, the earlier statutes were repealed, and leasing was authorized for the first time in Alaska.

With certain exceptions, the provisions of the Mineral Leasing Act of February 25, 1920, have always applied to Alaska as well as the continental United States. The most important exception is as to coal lands or deposits of coal, which are specifically excepted as to Alaska by Section 2 of the 1920 Act. Authority for the issuance of coal permits, leases, and licenses for the free use of coal in Alaska from October 1914 through September 1959, is found in the Alaska Coal Leasing Act of October 20, 1914, as amended.

The Alaska Coal Leasing Act of October 20, 1914, as amended, authorized the Secretary of the Interior to (a) divide into leasing units and award leases of the coal, lignite, and associated minerals in the unreserved coal lands and coal deposits owned by the United States in Alaska, (b) issue permits to prospect unclaimed and undeveloped areas of coal lands and coal deposits in Alaska, and (c) issue limited licenses or permits to prospect for, mine, and dispose of, for free use, coal on specified tracts belonging to the United States in Alaska.

The maximum acreage for a single lease or permit was 2,560 acres and the maximum aggregate holding by any person, association, or corporation was the same, except as relaxed under Section 4 of the act where satisfactory showing was made by a lessee that all workable deposits in his tract will be worked out within three years. Leases were for periods of not more than 50 years subject to renewal. They were not assignable or subject to reletting except with consent of the Secretary of the Interior. Prospecting permits were issued for a period of not to exceed four years. A permittee who showed, before the expiration of his permit, that the lands included in the permit contained coal in commercial quantities, was entitled to a preference right to lease all or part of the land.

Limited licenses or permits to provide for the supply of strictly local and domestic needs for coal were limited to specified tracts not to exceed ten acres to any person, association, or corporation, with the total life of any such license being limited to ten years.

Coal leases issued under the Act of October 20, 1914, provide for minimum royalties of two cents per ton, and annual rentals at the rate of \$.25 per acre for the first year after issuance of the lease, \$.50 per acre for the second, third, fourth, and fifth years, and \$1 per acre thereafter. Such rentals for each year being credited however, against the royalties as they accrue for that year.

The Act of October 20, 1914 (38 Stat. 741) relating to the survey of coal lands in Alaska was repealed by Public Law 86-252, S 1, September 9, 1959, 73 Stat. 490. The repealing act further amended the first sentence of Section 2 of the Act of February 25, 1920 (41 Stat. 437, 438), as amended (30 U.S.C., Sec. 201) by deletion of the words "outside of the Territory of Alaska."

This brought coal leasing in Alaska under the 1920 Mineral Leasing Act (as amended).

ENVIRONMENTAL CONCERNS

Adverse effects on the natural and human environment resulting from the mining and utilization of coal have become major national concerns in recent years. Americans have become increasingly aware that they cannot take their environment for granted, because the quality of life in the United States is directly related to the quality of the environment. Ever-increasing demand for coal as a primary energy source, coupled with great technological development in extraction techniques and abilities have led to major increases in coal mining, especially in surface mining.

Human Population and Patterns. Coal mining has influenced the social, economic, and political environment of populations living in coal mining areas. The impact of large scale coal operations and mine-mouth powerplants on rural, sparse populations can be of major consequence. Patterns of industrialization can develop haphazardly according to vagaries of ownership patterns and financial opportunity, or various controls can be applied to direct new economic growth in more or less structured patterns.

OCCURRENCE OF FEDERAL COAL

Coal is by far the most abundant and potentially the most valuable mineral resource in the United States. Coal-bearing rocks containing an estimated 3,224 billion tons of coal (Averitt, 1973), underlie about 13 percent of the land area of the 50 states and are present in varying amounts in parts of 37 states (Trumbal, 1960; Barnes, 1961). However, only a part is minable with today's technology and economic conditions. Coal has been mined in the eastern part of the country since the days of early settlement (1787) and the Appalachian region in 1970 still accounted for about 78 percent of the total bituminous coal production of the United States. Because of air quality legislation, emphasis is changing, and the vast coal deposits of the Rocky Mountain region are gaining importance primarily because of their low sulfur content, thick beds, and general availability by strip-mining methods.

Definition of Coal

Coal is defined as a readily combustible rock containing more than 50 percent by weight and more than 70 percent by volume of carbonaceous materials including inherent moisture formed from compaction and induration of variously altered plant remains similar to those in peat.

Character and quality (as defined by rank and grade), are the factors that determine coal's relative value and usefulness. These factors are controlled principally by conditions during formation and the depth of burial of the coal.

Coal Formation

Coal is composed of plants and plant fragments that accumulated in ancient fresh or brackish water marshes and swamps. As this plant material increased in quantity, year after year, in the swampy environment, the lower layers were compacted under the weight of the upper layers, and, in time, became peat, the initial stage in the formation of coal. Later, the swamps were covered by the sea or by meandering rivers that flooded, burying the layers of vegetation under accumulations of clay, sand, and silt.

The accumulation of peat requires a humid climate to support a rich growth of vegetation and a high water table to permit prolonged accumulation of plant material in a reducing environment. Most of the large coal deposits of Pennsylvanian age that are mined extensively in the eastern and central United States were developed from peat beds formed near sea level--some in estuaries or coastal lagoons, others on large deltas or coalescing deltas, and others on broad, low-lying coastal plains.

Many of the younger large coal deposits of Cretaceous and Tertiary age found in the West were not deposited near the sea. Instead, they formed in intercontinental basins characterized by broad interconnected swamps, lakes, and flood plains of large river systems. Some of these river systems may have formed on the nearly flat tidal plains exposed when the land was uplifted and ancient seas migrated out. Others were formed in nonmarine environments millions of years after the land was last covered by the sea.

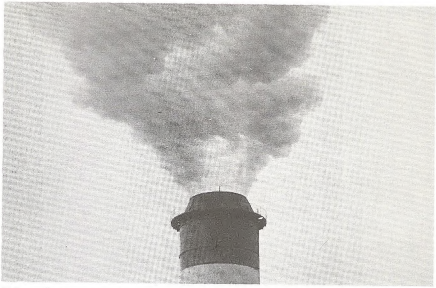
Development of thick coal beds of wide extent required a unique set of conditions: (1) Very large and wide coastal or flood plains, (2) a prolonged optimum rate of plant growth and accumulation, (3) nearly stable condition with a slow rate of subsidence, and (4) an equally slow encroachment of the sea or migrating of river valleys over periods measured in centuries or millennia to sustain these conditions for periods long enough to accumulate the nearly pure vegetal piles necessary to form thick beds of coal.

The transgressing seas or migrating river channels ultimately covered the peat-forming swamps and terminated plant growth. The eroding land-masses continued to supply sand, silt, and mud and this material was deposited in layers over the submerged peat swamps. In time, depending on the rate of sedimentation, the depth of the transgressive area in marginal marine areas, and the rate of subsidence or sinking of the basins, this sedimentary material built-up new flood plains, swamps, deltas, lagoons, and coastal plains conducive to the development of new younger peat-forming swamps.

Weight of the overlying sedimentary cover, heat produced by depth of burial, and pressures and heat accompanying structural deformation all contribute to the progressive compaction and devolatilization of peat to form the various ranks of coal.

Classification of Coal

Coal is classified according to a particular property such as degree of metamorphism or "coalification" (*rank*), constituent plant materials (*type*), or degree of impurity (*grade*). The rank of a particular coal is established according to the percentage of fixed carbon and the heat content, calculated on a mineral-matter-free basis. As shown in Figure 1-3, the percentage of fixed carbon and the heat (BTU) content increases from low rank lignite to higher rank bituminous coal as the percentages of volatile matter and moisture decreases. These changes are primarily the result of depth and accompanying heat of burial, compaction due to weight of overlying deposits, and structural deformation. *Rank* is thus a way of expressing the progressive metamorphism of coal. It is quite independent of *grade* which is a way of expressing quality; however, a few local observed differences in *rank* are attributed to difference in the nature of the coal-forming material (differences in coal *type*).



Major pollutants, through stack emissions, are particulates and gasses such as those rising from this stack.

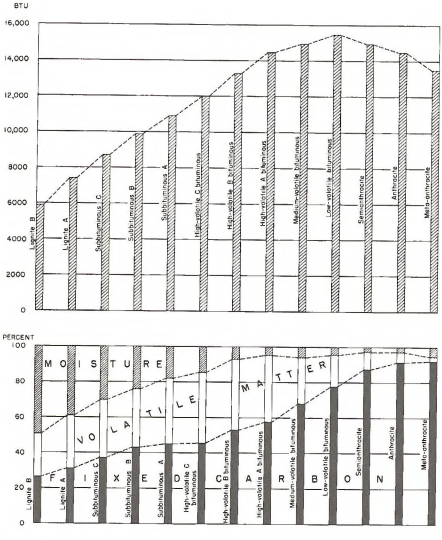


Figure 1-3. Coal classification by rank.

On a regional scale, the required amount of heat to form coal is produced by the normal geothermal gradient accompanying depth of burial (approximately 25° C per kilometer). This, in turn, is related to the geological age of the beds, because the older beds are more likely to have been buried deeper than the younger beds, and thus subjected to more heat and pressure over a longer period of time. In most of the Rocky Mountain states, this relation is demonstrated by the fact that older coal beds of Cretaceous age are generally of high-volatile bituminous rank, whereas the younger overlying beds of Tertiary age are generally subbituminous or lignite in rank. The terms "lignite," "subbituminous coal," "bituminous coal," and "anthracite" thus describe stages in the coal forming process.

Coal is classified by grade largely according to the content of ash, sulfur, and other deleterious constituents. Thus far in work on coal resources, a preliminary classification on the basis

of sulfur content has been made, but classification on the basis of ash content has not been made because ash is a more highly variable component than sulfur. Coal contains widely varying amounts of sand, silt, and mud that were washed into the coal swamps; and this admixed sediment forms the bulk of the ash of burned coal.

In recent years, information on minor or trace elements in coal has increased somewhat, but classification according to trace element content is not yet possible.

Sulfur is an undesirable element when associated with coal. It lowers the quality of coke and the resulting iron and steel products. It contributes to corrosion, to the formation of boiler deposits, and to air pollution. Its presence in spoil banks inhibits the growth of vegetation. As sulfuric acid, it is the main deleterious compound in acid mine waters, which contribute to stream pollution. The sulfur content of coal in the United States ranges from 0.2 to about 7.0 percent by weight, but most of the Rocky Mountain and Northern Great Plains coal is less than 1.0 percent. Sulfur occurs as a constituent of pyrite and marcasite (FeS_2); hydrous ferrous sulfate ($FeSO_4 \cdot 7 H_2O$), derived by weathering of pyrite; gypsum ($CaSO_4 \cdot 2 H_2O$), and as organic sulfur in combination with the coal-forming vegetal material (Walker and Hartner, 1966).

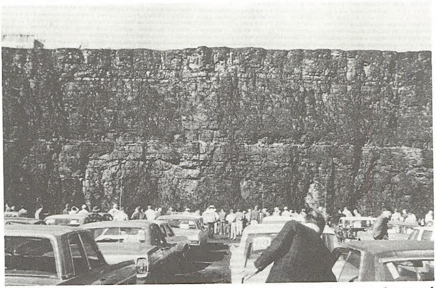
The percentage of sulfur and of pyritic sulfur is highest in bituminous coals of Pennsylvania age in the Eastern and Interior Coal Provinces. The percentage is relatively low, generally less than 1 percent, in subbituminous coal and lignite of the Rocky Mountain and Northern Great Plains Coal Provinces. This relation is shown in Table 1-7.

The conspicuously large percentage of low-sulfur coal in the United States, shown on the last line of Table 1-7, is primarily due to the fact that the resources of low-sulfur subbituminous coal and lignite concentrated in the Rocky Mountain and Northern Great Plains Coal Provinces represent about 54 percent of total identified resources.

The difference in BTU values of coals affects the amount of sulfur per ton a "low sulfur" coal might contain. Generally, coal with less than 1 percent sulfur is considered low sulfur coal. However, classification of coal into sulfur groups primarily relates to air pollution problems. The break point in sulfur content (high sulfur-low sulfur) is the point which would give emission of 1.2 pounds SO_2 per million BTU input to a combustion process. A 12,000 BTU per pound coal containing about 0.72 percent sulfur would be at the break point. An 8,500 BTU per pound coal containing about 0.51 percent sulfur would be at the break point. The lower BTU example approximates sub-bituminous coal from the Northern Great Plains, while the higher BTU example would be closer to average bituminous coal from the Eastern Coal Province.

Coal contains small quantities of virtually all metallic and nonmetallic elements, that had been introduced into the coal bed in one or all of four different ways:

1. As inert material washed into the coal swamp at the time of plant accumulation.



The Northern Great Plains and Rocky Mountain areas are gaining importance because of their low sulfur sub-bituminous coal and lignite which is easily accessible by strip mining. A good example is this 90 foot seam at the Wyodak mine near Gillette, Wyoming.

Table 1-7
Distribution, in Percent, of Identified[1] United States Coal Resources According to Rank and Sulfur Content[2]

Rank	Sulfur Content (In Percent) Low 0-1.0	Medium 1.1-3.0	High 3+
Anthracite	97.1	2.9	–
Bituminous coal	29.8	26.8	43.4
Sub-bituminous coal	99.6	.4	–
Lignite	90.7	9.3	–
All ranks	65.0	15.0	20.0

[1]Identified resources: Specific, identified mineral deposits that may or may not be evaluated as to extent and grade, and whose contained minerals may or may not be profitably recoverable with existing technology and economic conditions.
[2]From DeCarlo, Sheridan, and Murphy (1966).

2. As a biochemical precipitate from the swamp water.
3. As a minor constituent of the original plant cells.
4. As a later addition, introduced after coal formation, primarily by ground water moving downward and laterally.

When coal is burned, most of these elements are concentrated in the coal ash, but a few of the more volatile elements are emitted into the atmosphere. Coal ash is composed largely of the oxides of silicon, aluminum, iron, calcium, magnesium, potassium, sodium, and sulfur, which typically make up 93 to 98 percent of the total weight of the ash, (Abernethy and others, 1969a). The remaining few percent of coal ash is made up of small individual amounts of many other elements, which differ in variety and quantity in different areas and beds. These elements are generally measured in parts per million or billion, and for this reason are termed minor elements, although they may not be minor elements in other contexts.

The minor elements in coal are of considerable interest because some may be important as future resources while others may be pollutants. Most of the minor elements occur in coal in about the same concentration as their estimated concentration in the earth's crust, but 25-30 elements occur locally in greater concentration and these have received the most study. A few elements, noteably uranium, germanium, arsenic, boron, and beryllium, occur locally in vastly greater concentrations than their estimated concentration in the earth's crust; others, including arsenic, barium, bismuth, cobalt, copper, fluorine, gallium, lanthanum, lead, lithium, mercury, molybdenum, nickel, scandium, selinium, silver, strontium, tin, vanadium, yttrium, zinc, and zirconium, occur locally in appreciably greater concentrations. Other elements of interest that generally occur in lower concentrations than those listed above include chromium, magnesium, phosphate, tellurium, thallium, titanium, and tungsten. It should be noted that the concentration of an element in excess of the estimated concentration in the earth's crust, although of great interest and geologic significance, does not necessarily imply an economic or paramarginal concentration, because that is determined by the concentration in typical commercial sources of the respective element.

Geographic Location of Coal Deposits

Lands underlain by coal in the United States can be geographically classified into four levels. In descending order, these categories are: (1) Coal provinces, (2) Coal regions, (3) Coalfields, and (4) Coal districts (Campbell, 1929).

PROBABLE OCCURRENCE OF COAL

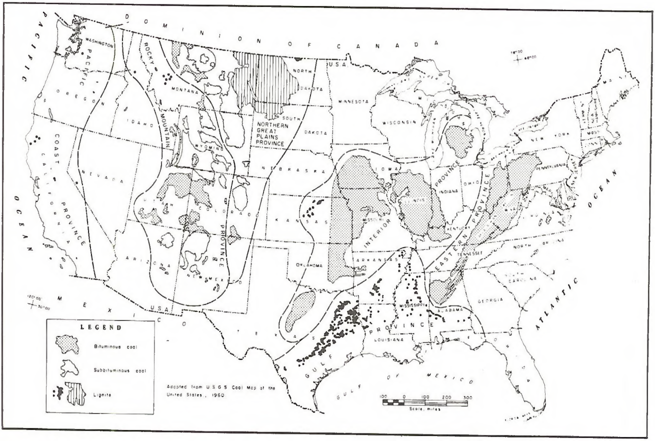


Figure 1-4. Map of geographic location of coal deposits in the contiguous 48 United States.

Coal provinces are major groupings of coal deposits, largely on the basis of geologic age, geologic structural setting, quality of coal, and location. Coal provinces roughly correspond to the major physiographic divisions and cover nearly the same broad geographic areas. The six coal provinces are: (1) Pacific Coast Provinces, including Alaska, in this report, (2) Rocky Mountain Province, (3) Northern Great Plains Province, (4) Interior Province, (5) Gulf Province, and (6) Eastern Province.

The provinces are made up of the coal *regions* which are groups of coal fields geographically related or having some geomorphic or geographic feature or features in common.

Coalfields, the next smaller subdivision, are generally separate from one another, but also have some special geographic identity or characteristic coal quality.

Coal districts represent the smallest subdivision and are areas where mining has been developed around a fairly definite geographic center or on a given coal bed or group of beds.

Pacific Coast Coal Province. The Pacific Coast Coal Province includes coal regions and fields in California, Oregon, Washington, and Alaska.

The coalfields in California and Oregon are small and generally contain coal of low rank and poor quality. Only limited mining in these states has been attempted. Washington, on the other hand, has produced coal ranging from lignite to anthracite, including some coking coal, from several fields concentrated in the western part of the state. The coal-bearing rocks of those states range from Eocene to Miocene in age.

Alaskan coalfields contain extensive coal resources chiefly of Cretaceous and Tertiary age that range in rank from lignite to coking low-volatile bituminous. Several fields occur in the south-central part of Alaska. The Arctic Slope region, the largest of the Alaskan coal deposits also is known as the northern Alaska fields. Long distance to ready markets discourage large scale development of Alaskan coal deposits.

Rocky Mountain Province. The coal lands of the Rocky Mountain and Northern Great Plains Coal Provinces total about 193,345 square miles and contain most of the Federally owned coal in the United States. The Rocky Mountain Coal Province includes eight coal regions as well as several, small isolated fields and basins.

The regions include the Big Horn Basin region in northern Wyoming and south central Montana, the Yellowstone region in southwestern Montana, the Hams Fork region that

Table 1-8
Analyses of Coal From Principal Regions Where Federal Coal Occurs

Coal Province and Region	Proximate Analysis (As Received): Moisture Percent	Volatile Matter Percent	Fixed Carbon Percent	Ash Percent	Sulfur Percent	BTU Per Lb.
Northern Great Plains						
Fort Union	30.5 - 42.8	24.5 - 27.7	25.1 - 35.9	4.1 - 9.6	0.2 - 1.2	5675-7660
Powder River	21.4 - 33.5	27.8 - 39.0	32.5 - 41.5	3.9 - 9.14	0.2 - 1.1	7220-9720
North-Central	6.6 - 22.6	28.2 - 30.2	36.6 - 46.4	8.8 - 18.2	0.6 - 2.7	8580-10210
Denver	15.5 - 35.0	37.3 - 41.8	51.5 - 56.2	2.3 - 18.2	0.1 - 1.1	5510-10660
Raton	1.0 - 10.2	22.9 - 40.0	50.0 - 54.5	5.3 - 21.8	0.4 - 1.3	10310-13970
Interior Province						
Western (E. Oklahoma area)	2.2 - 3.5	17.3 - 37.2	68.1 - 72.7	5.5 - 8.5	0.5 - 1.1	13010-14310
Rocky Mountain Province						
Big Horn	9.5 - 17.2	33.6 - 34.2	38.1 - 47.4	2.8 - 12.0	0.4 - 1.1	9740-11650
Hams Fork	5.6 - 22.7	33.5 - 38.4	40.5 - 49.8	1.7 - 6.2	0.6 - 0.8	9720-12650
Wind River	22.3 - 24.6	27.7 - 32.5	39.9 - 40.0	5.2 - 7.8	0.5 - 1.1	8610-9530
Green River	6.5 - 25.0	28.0 - 45.6	27.0 - 54.6	3.5 - 25.0	0.4 - 5.0	5000-12572
Hanna Field*	11.1 - 14.1	33.3 - 39.4	41.6 - 50.1	3.8 - 7.8	0.5 - 1.1	10290-11450
Uinta (Utah)	4.1 - 16.3	35.9 - 41.9	42.4 - 51.7	5.4 - 11.0	0.5 - 1.3	10400-13220
Uinta (Colorado)	2.2 - 14.6	8.4 - 37.6	45.4 - 80.2	3.2 - 13.6	0.4 - 1.1	10830-14120
San Juan River	3.3 - 16.2	35.4 - 40.9	38.0 - 50.8	3.1 - 11.8	0.4 - 0.9	10150-13120
Southwestern Utah	12.0 - 17.4	36.0 - 42.2	30.0 - 46.0	4.0 - 15.8	0.7 - 6.1	10390-11020

Data from Fieldner, A.C., Rice, W.E., and Moran, H.E., 1942, Typical analyses of coals of the United States: U.S. Bureau of Mines Bulletin 446, p. 45 modified by data from Keystone Coal Industry Manual, 1972; Glass, 1972; Hombaker and Holt, 1973; and Pillmore. C.L., 1970.

*Smith, J.B., et al, 1972, Strippable Coal Resources of Wyoming: U.S. Bureau of Mines Information Circular 8538, p. 47.

lies mainly in Wyoming, but includes fields in Idaho, and northeastern Utah, the Wind River region in central Wyoming, the Green River region in Wyoming including Hanna and northwestern Colorado, the Uinta Basin region of eastern Utah and west central Colorado, the San Juan River region in Colorado and New Mexico, and the southwestern Utah region.

The Rocky Mountain Coal Province contains a greater variety of coal than any other province in the United States. The coal ranges from lignite to anthracite and includes all of the coal ranks.

The coal-bearing rocks range in age from Cretaceous to Miocene and are contained mostly in large structural basins throughout the province. The depth of burial ranges from surface outcrop to as deep as 20,000 ft.

Extensive deposits of high-quality coking coal are contained in the Uinta region and the Southwestern Utah and San Juan River regions. Also of immediate importance in these regions are the large reserves of bituminous to subbituminous coal suitable for large-scale power generation.

The Northern Great Plains Coal Province. This province includes coal regions and fields that lie in the Great Plains east of and adjacent to the Rocky Mountains. The province includes the Black Hills region in Wyoming, the Assinniboine and Judith River regions in Montana, the huge Fort Union region of eastern Montana and North and South Dakota, the Powder River region of northeastern Wyoming and southwestern Montana, and also the Denver Region of Colorado and the Raton Mesa region of southeastern Colorado and northeastern New Mexico.

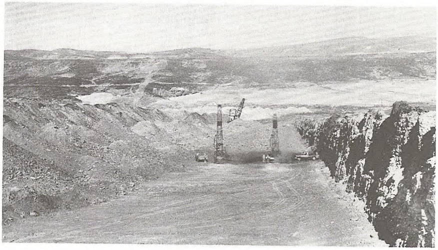
The coal-bearing rocks throughout the Great Plains east of the Rocky Mountains are little disturbed, and largely flat-lying, and commonly accessible by surface or underground mining methods. The coals are mostly either lignitic or subbituminous except in regions adjacent to the mountains where they are generally higher rank. The Raton Mesa region in New Mexico, for instance, produces high-volatile bituminous coal with excellent coking properties.

One of the largest coal regions in the Northern Great Plains Coal Province is the Fort Union region in eastern Montana, and North and South Dakota. This is Peabody Coal Company's Big Sky Mine at Colstrip, Montana.

Rapidly increasing demands for low-sulfur coal suitable for burning in modern large thermal powerplants have precipitated extensive exploration and development of the huge coal reserves of the Powder River region. The concentration of coal reserves in this area is the largest of any area of comparable size in the United States. The coal occurs in beds as thick as 220 feet and commonly lies less than 150 feet below the surface. The coal is largely Federally owned and will play a dominant role in future leasing operations.

The Gulf Coal Province. The Gulf Coal Province extends northeasterly from southeast Texas into Louisiana, Arkansas, and Tennessee and then southeasterly across Mississippi into southern Alabama. The area includes only two coal regions, the Texas region and the Mississippi region. Ranging in age from Upper Cretaceous to Eocene, the coals of this province are mostly lignite and have been mined in only a few localities in the state of Texas.

The Interior Coal Province. The Interior Coal Province covers part of eleven states and is divided into four regions as follows: the Northern region which lies completely within the state of Michigan; the Eastern region which covers most of Illinois and parts of western Indiana and Kentucky; the Western region which extends from Oklahoma to Iowa and includes parts



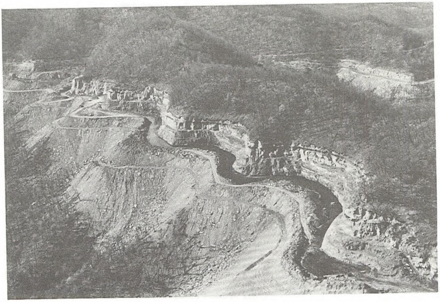
Drills at work preparing holes for blasting at the Edna mine in the Uinta region near Oak Creek, Colorado.

of Kansas, Nebraska, Missouri, and Arkansas; and the Southwestern region which lies mostly in north-central Texas.

The coal-bearing rocks of the various regions in the Interior Coal Province are Pennsylvanian in age, older geologically than those of the provinces to the west, and the coals are mostly higher in rank on the average (high volatile bituminous), but also generally higher in sulfur content. The coal has been used extensively for power generation and as a blend with eastern coals to produce metallurgical coke, but future pollution controls will greatly restrict its continued use unless acceptable sulfur removal techniques are found.

The Eastern Coal Province parallels the East Coast and extends along the Appalachian Mountains from Pennsylvania to Alabama. It is made up of the Anthracite region of Pennsylvania, the Atlantic Coast region of Virginia and North Carolina, and the Appalachian region which covers parts of Ohio, Pennsylvania, Virginia, West Virginia, eastern Kentucky, Tennessee, and northern Alabama. Though about half the size of the Interior Coal Province, the Eastern Coal Province contains more coal and remains the most important coal province in the United States on the basis of production and rank of coal produced.

The coal beds of the Eastern Coal Province are mostly about the same age as those in the Interior Coal Province, but they lie in rocks in and near the structurally disturbed Appalachian fold belt. From west to east they progress in rank from high volatile bituminous to anthracite. As is the case, in the Interior Coal Province, most of the coal is relatively high in sulfur content, except in West Virginia, Virginia, Kentucky, and the Pennsylvania Anthracite area where good-sized reserves of low and medium sulfur coal are reported.


How some contour-strip mines on privately owned land were left before States in Appalachia had effective mined-land reclamation laws.

Geologic Age of the Coal Beds of the United States

Coal beds in the United States range in age from lower Carboniferous (Mississippian) to Miocene (10 to 340 million years). The Carboniferous Age is Called the "Age of Coal" and is considered as a single period in Europe. In this country, it includes both the Mississippian and Pennsylvanian periods. The Eastern and Interior Provinces contain nearly all the Carboniferous coals in the United States plus some limited coal deposits of Permian and Triassic age. The Gulf province and the provinces of the west include within their borders nearly all of the Cretaceous and Tertiary age coal beds. In a broad sense, the period designation or age of the coal also denotes the quality.

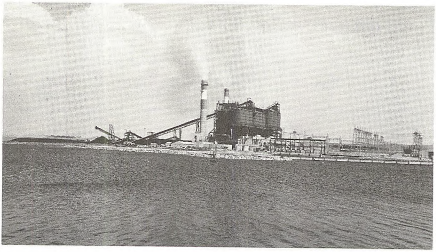
Though some of the coal deposits found in the western provinces are of higher rank, most of the large deposits are subbituminous and lignitic. In the Eastern and Interior provinces, the coal is mostly bituminous to anthracite. Age does not necessarily determine quality, but, all other things being equal, the older the coal, the longer it has been subjected to coal-forming or rank-increasing factors such as heat and pressure. The young higher rank coal beds in the west have been subjected to sufficient heat and pressure to cause devolatilization, thus improving the quality.

Ownership of Coal Lands

Coal in the United States is held by several broad classes of owners, including the Federal and State Government, mining and manufacturing corporations, railroads, Indian tribes, and private individuals. Information about the ownership of the surface, coal, and other mineral rights for any individual tract of land can be ascertained from the records of appropriate County, State, or Federal agencies.

Most of the coal lands in the Eastern and Interior Coal Provinces are privately owned. In the Appalachian basin, many large tracts of coal land are held by mining, manufacturing, or landholding corporations. In this area also, the main eastern coal-hauling railroads own some coal lands along their rights-of-way. In areas remote from transportation facilities, some coal acreage is owned by individual counties, having been acquired during the depression of the 1930's through failure of the owners to keep up real estate tax payments. Federal coal constitutes a very small part of the total in the East.

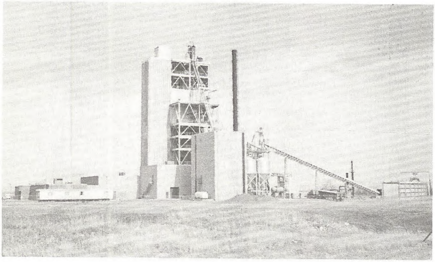
Most of the coal lands in the Rocky Mountain and Northern Great Plains Coal Provinces are owned by the Federal Government. The Bureau of Land Management maintains records showing disposition and retention of lands and rights by the Federal Government.



Arizona Public Service Company's Four Corners power plant, near Farmington, New Mexico, consumed 6 million tons of coal in 1973.

Early transcontinental railroad companies received grants of considerable land, including coal rights, adjoining the rights-of-ways. The Northern Pacific Railroad, for example, received odd-numbered sections in a checkerboard pattern for a distance of 40 miles on both sides of the right-of-way. The Union Pacific and Santa Fe Railroads received odd-numbered sections for a distance of 20 miles on both sides of their rights-of-way. At the time of these grants, the extent and potential value of the coal lands could only be surmised.

Subsequently, the railroads made many exchanges of land to accommodate homesteaders, States, and the Federal Government. The grant to the Santa Fe, for example, resulted in ownership of coal lands in the southern part of the San Juan basin of New Mexico, south of the Navajo Indian Reservation. At a later date, when it became desirable to enlarge the reservation southward, the Santa Fe lands in the path of the expansion were, by request, exchanged for a relatively solid block of coal land of comparable acreage east of the reservation. The railroads sold some land, including coal rights, to early settlers; and they sold much larger amounts, exclusive of coal rigths, to later settlers. As a result of exhcanges and sales, the current pattern of coal ownership by the western railroads differs considerably fiom that of the original grants, but the western railroads as a group still hold the second largest acreage of coal land in the Rocky Mountain and Northern Great Plains Coal Provinces.



This pilot lignite gasification facility at Rapid City, South Dakota is operated by the Interior Department's Office of Coal Research.

In Oklahoma, New Mexico, and Arizona, fairly large acreages of coal land are owned by the various Indian tribes, who are assisted by the Bureau of Indian Affairs in coal lease administration.

In Washington and Oregon, the percentage of coal land owned privately is somewhat higher than it is in the Rocky Mountain region, but even in these States the Federal Government manages substantial areas of coal land.

PAST AND PRESENT COAL PRODUCTION

The first bituminous coal mining in America began in Virginia in 1787. The earliest record of production was in 1820 when 3,000 tons of coal were produced. Production of a million tons of anthracite was reached in 1837 and the same tonnage for bituminous coal in 1850 (E.S. Moore, 1922), coal production reached the 100 million ton level in 1880. It exceeded the 200 million ton rate by the turn of the century, (Bureau of Mines, 1920). The gradual growth of coal production increased to 579 million tons in 1918 during the peak production years during and following World War I. Production remained somewhat steady until the depression years when it dropped to a low of 310 million tons in 1932. The industry operated at a deficit during the 1930s. As the economic demands of the country grew, coal production grew to a sustained production of over 460 million tons in 1940. The alltime peak production year was 1947 when 631 million tons of coal were produced. This peak was achieved just three years after the railroads began changing from coal to diesel fuel in 1944. Transportation, both railroads and ships, at that time were using 132 million tons of coal annually.

Coal production was sporadic from 1947 to 1961. It dropped to a low of 392 million tons in 1954, up to 501 million tons in 1956 and back down to

403 million tons in 1961. From 1961 to 1973, there was a steady growth with the exception of a minor drop in 1968, caused by strikes.

A major effect upon coal production from 1947 to 1961 was the steadily increasing availability of oil and gas. The convenience of use, competitive price, and new technology of the oil and gas industry resulted in its increasing role in meeting the energy requirements of the country. Coal's contribution to the total U.S. energy demand dropped from 43.5 percent in 1947 to 21 percent in 1961 (Bureau of Mines, 1970).

The transportation market for coal has virtually disappeared. Household and commercial space heating have drastically declined. But there has been a tremendous growth in coal consumption for the electric utilities.

Table 1-9, production of bituminous coal, by type of mine, relates the production of coal from 1900 to 1970. It also breaks down the mining methods which include strip, auger, and underground mining (Keystone Coal Industry Manual, 1972).

The first production figures for strip mining were in 1915 when less than 1 percent of the nation's total was mined by stripping. By 1930, stripping accounted for 5 percent of coal mined. This figure rose to 10 percent in 1940; 20 percent in 1950; 30 percent in 1960; 35 percent in 1969; and 40 percent in 1970.

In 1969, the Federal Government passed the Federal Coal Mine Health and Safety Act. The requirements of this act increased the cost of underground operations and virtually closed out the small independent underground coal miner. Stripping operations are rapidly growing in the Appalachian area. Nearly all of the coal mines in New Mexico, Arizona, North Dakota, Montana, and Wyoming are surface mines. However, much high quality, high-BTU coal from Colorado, New Mexico and Utah continues to be mined by underground methods. There has been little auger mining in the west.

Table 1-10 shows cumulative Federal coal production through 1971. The production value represents the value

Table 1-9
Production of Bituminous and Lignite Coal, by Type of Mines
Thousands of Short Tons

Year	Strip Mining	Auger Mining	Underground Mining	Total Production
1900	–	–	212,316	212,316
1905	–	–	315,063	315,063
1910	–	–	417,111	417,111
1915	2,832	–	439,792	442,624
1920	8,860	–	559,807	568,667
1925	16,871	–	503,182	520,053
1926	16,923	–	556,444	573,367
1927	18,378	–	499,385	517,763
1928	19,789	–	480,956	500,745
1929	20,268	–	514,721	534,989
1930	19,842	–	447,684	467,526
1931	18,932	–	363,157	382,089
1932	19,641	–	290,069	309,710
1933	18,270	–	315,360	333,630
1934	20,790	–	338,578	359,368
1935	23,647	–	348,726	372,373
1936	28,126	–	410,962	439,088
1937	31,751	–	413,780	445,531
1938	30,407	–	318,138	348,545
1939	37,722	–	357,133	394,855
1940	43,167	–	417,604	460,772
1941	55,071	–	459,078	514,149
1942	67,203	–	515,490	582,693
1943	79,685	–	510,492	590,177
1944	100,893	–	518,678	619,576
1945	109,987	–	467,630	577,617
1946	112,964	–	420,958	533,922
1947	139,395	–	491,229	630,624
1948	139,506	–	460,012	599,518
1949	106,045	–	331,823	437,868
1950	123,467	–	392,844	516,311
1951	117,618	205	415,842	533,665
1952	108,910	1,506	356,425	466,841
1953	105,448	2,291	349,551	457,290
1954	98,134	4,460	289,112	391,706
1955	115,093	6,075	343,465	464,633
1956	127,055	8,045	365,774	500,874
1957	124,109	7,946	360,649	492,704
1958	116,242	7,320	286,884	410,446
1959	120,953	7,641	283,434	412,028
1960	122,630	7,994	284,888	415,512
1961	121,979	8,232	272,766	402,977
1962	130,300	10,583	281,266	422,149
1963	144,141	12,531	302,256	458,928
1964	151,859	13,331	321,808	486,998
1965	165,241	14,186	332,661	512,088
1966	180,058	15,299	338,524	533,881

Source: U.S. Bureau of Mines

Table 1-9 (Continued)

Year	Strip Mining	Auger Mining	Underground Mining	Total Production
1967	187,134	16,360	349,133	552,626
1969	197,023	16,350	347,132	560,505
1970	244,117	20,027	338,788	602,932
1974	311,530	15,670	273,800	601,000

Source: U.S. Bureau of Mines

Table 1-10
Federal Coal Production Through 1971
(Does Not Include Indian Lands)

State	Total Tons	Total Production Value	Royalty Value
Alaska	16,982,283	$118,111,604	$ 1,874,585
California	1,257	3,190	299
Colorado	35,383,196	183,794,137	4,717,376
Idaho	31,574	88,984	7,228
Illinois (ACQ)	24,170	92,128	3,138
Kentucky (ACQ)	1,011,795	4,278,280	166,641
Montana	22,939,102	35,084,777	2,371,357
Nevada	141	207	133
New Mexico	3,432,964	10,843,992	642,614
North Dakota	23,288,393	41,723,187	1,995,846
North Dakota (ACQ)	116	334	7
Ohio (ACQ)	489,461	2,066,465	89,459
Oklahoma	5,876,324	40,884,344	932,462
Oregon	18,900	240,719	23,891
South Dakota	41,435	69,381	7,119
Tennessee (ACQ)	974	81,340	4,452
Utah	90,390,240	374,031,424	11,153,937
Virginia (ACQ)	798	4,589	119
Washington	838,669	2,163,110	114,643
Wyoming	66,976,008	219,729,389	7,386,867

(ACQ) Acquired Lands

Geological Survey (1972)

of coal produced. The royalty value is the amount of money returned to the Federal Government for the right to mine the coal. The coal was mined from acquired lands in Illinois, Kentucky, Ohio, Tennessee, Virginia, and a small portion of North Dakota. There has been no Federal coal mined in California since 1951. The last production in Idaho was in 1955. The Federal coal mined from acquired land in Illinois was during the years 1959 to 1965. The production figures only go back to 1955 in Kentucky. The production figures start in 1947 in Ohio and 1949 in Oklahoma. Federal coal in Tennessee was mined from 1956 to 1960 and in Virginia during 1956 and 1957.

The combined total of coal produced from Federal leases and from Indian land varied between 1.2 and 2.0 percent of the total U.S. production from 1950 through 1970. This combined total percentage rose to 3.1 percent in 1971 (Geological Survey, 1972). The total percentage of Federal coal production will tend to rise as Federal leases come into greater production in the Western States, and as new leases are issued under terms providing for early production.

COAL RESERVES AND RESOURCES
(Geological Survey – Bureau of Mines)

In discussions of most mineral commodities, it is customary to present data in at least two categories, one termed "reserves," and the other termed "total resources."

Within this classification system the term "coal resource" designates the estimated quantity of coal in the ground in such form that economic extraction is currently or potentially feasible. The "coal reserve" is that relatively small part of the resource for which both quality and quantity have been reasonably determined and which is deemed to be minable at a profit under existing market conditions. The system employs a concept by which coalbeds are classified in terms of their degree of geologic identification and economic or technologic feasibility of recovery. In the following conceptual diagram showing the relationship of the various factors involved, coal resources are located on the horizontal scale, increasingly to the left, according to their degree of geological assurance of existence, and on the vertical scale, increasingly upward, according to their degree of economic feasibility.

The following general definitions of coal resource categories are amplified by the criteria for resource identification which follows this Glossary. The criteria may be revised to reflect changing economic or technologic conditions without affecting the definitions.

- *Resource* – A concentration of coal in or on the earth's crust in such form that economic extraction is currently or potentially feasible.
- *Identified resources* – Specific bodies of coal whose location, quality, and quantity are known from geologic evidence supported by engineering measurements with respect to the demonstrated category.
- *Undiscovered resources* – Unspecified bodies of coal surmised to exist on the basis of broad geologic knowledge and theory.

Table 1-11
U.S. Coal Resources on January 1, 1974
(Billion short tons)

	TOTAL RESERVES AND RESOURCES			
	IDENTIFIED			UNDISCOVERED (HYPOTHETICAL)
	Measured	Indicated	Inferred	
ECONOMIC	56[1] (437 In-Place) RESERVES	163[1]	UNDETER-MINED	UNDETERMINED
SUBECONOMIC	69[2] RESOURCES	262[2]	1,031[2]	1,643[3]

Increasing degree of economic feasibility

Increasing degree of geologic assurance

CUMULATIVE PRODUCTION (1899-1972): 39.5 Billion Tons

[1] Includes Bituminous and Anthracite Beds ⩾28" thick to 1,000 ft. in depth.
Includes Subbituminous Beds ⩾60" thick to 1,000 ft. in depth.
Includes Lignite Beds ⩾60" thick to 120 ft. in depth.
[2] Includes Bituminous and Anthracite Beds 14-28" thick to 1,000 ft. in depth.
Includes Bituminous and Anthracite Beds ⩾14" thick at 1,000-3,000 ft. in depth.
Includes Subbituminous Beds 30-60" thick to 1,000 ft. in depth.
Includes Subbituminous Beds ⩾30" thick at 1,000-3,000 ft. in depth.
Includes Lignite Beds 30-60" thick to 120 ft. in depth.
Includes Lignite Beds ⩾30" thick at 120-3,000 ft. in depth.
[3] Includes Bituminous and Anthracite Beds ⩾14" thick to 6,000 ft. in depth.
Includes Subbituminous and Lignite Beds ⩾30" thick to 6,000 ft. in depth.

Source: Joint Geological Survey – Bureau of Mines Classification System for coal resources and reserves. (Proposed)

- *Reserve* – That portion of the identified coal resource that can be economically mined at the time of determination – also referred to as *Recoverable Reserve*. The reserve is derived by recoverability calculations from that component of the identified coal resource designated as the reserve base.
- *Identified-Subeconomic resources* – Coalbeds that are not Reserves, but may become so as a result of changes in economic and legal conditions.
- *Paramarginal* – The portion of Subeconomic Resources that (a) borders on being economically producible or (b) is not commercially available solely because of legal or political circumstances.
- *Submarginal* – The portion of Subeconomic Resources which would require a substantially higher price (more than 1.5 times the price at the time of determination) or a major cost reducing advance in technology.
- *Hypothetical resources* – Undiscovered coalbeds that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a Reserve or Identified-Subeconomic resource.
- *Speculative resources* – Undiscovered coalbeds that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in as yet unknown types of deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as Reserves or Identified-Subeconomic resources.

The following definitions for measured, indicated, and inferred are applicable to both the Reserve and Identified-Subeconomic resource components.

- *Measured* – Coal for which estimates of the quality and quantity have been computed, within a margin of error of less than 20 percent, from sample analyses and measurements from closely spaced and geologically well-known sample sites.
- *Indicated* – Coal for which estimates of the quality and quantity have been computed partly from sample analyses and measurements partly from reasonable geologic projections.
- *Demonstrated* – A collective term for the sum of coal in both measured and indicated resources.
- *Inferred* – Coal in unexplored extensions of Demonstrated resources for which estimates of the quality and size are based on geologic evidence and projection.

Distribution of Identified Resources by State

Identified coal resources are specific, identified coal deposits that may or may not be evaluated as to extent or grade and that may or may

not be profitably recovered with existing technology and economic conditions. The identified coal resources lying under 0-3,000 feet of overburden are listed in Table 10 by State and rank of coal. Table 1-12, which shows the total estimated remaining coal resources in the United States as of January 1, 1972, includes figures for resources in the ground. They include beds of bituminous coal and anthracite 14 in. or more thick and beds of subbituminous coal and lignite 2-1/2 ft or more thick (Averitt, 1973), even though thin coal beds under deep overburden may not be mined for many years.

Distribution According to Coal Province

The Distribution of coal resources is given in Table 1-13. Rêserves are "measured and indicated resources in thick and intermediate beds; includes bituminous coal and anthracite in beds 28 in. or more thick, and subbituminous coal and lignite in beds 5 ft or more thick."

The amount of coal that can be classified as reserves in the ground in the 0-1,000-ft overburden category is much larger in some states than in others because of differences in the thickness and number of coal beds, and differences in the structure and topography of the major coal-bearing basins.

The very large reserve tonnage in the Northern Great Plains Coal Province reflects the fact that coal beds are very thick, numerous, and closely spaced; the coal-bearing rocks are nearly flat-lying; and the topography is relatively flat over thousands of square miles in North Dakota, eastern Montana and northeastern Wyoming.

The modest reserve tonnage in Rocky Mountains Coal Province reflects the fact that in most of the provinces, the coal-bearing rocks are on the edges of moderately to steeply dipping structural basins. In parts of the province, particularly in the Wasatch Plateau and Book Cliffs of central Utah, the moderately dipping coal crops out at the bases of nearly vertical cliffs, and thus passes below 1,000 ft of overburden a short distance from the outcrops. All the

Table 1-12
Total Estimated Remaining Coal Resources
in the United States, January 1, 1972

Estimated Identified Resources Remaining in the Ground
Millions of Short Tons

State	Bituminous Coal	Sub-Bituminous Coal	Lignite	Anthracite and Semi-Anthracite	Total
Alabama	13,342	0	2,000	0	15,342
Alaska	19,413	110,668	[1]	0	130,081
Arizona	21,246	0	0	0	21,246
Arkansas	1,638	0	350	430	2,418
Colorado	62,339	18,242	0	78	80,659
Georgia	24	0	0	0	24
Illinois	139,124	0	0	0	139,124
Indiana	.34,573	0	0	0	34,573
Iowa	6,509	0	0	0	6,509
Kansas	18,674	0	0	0	18,674
Kentucky	64,842	0	0	0	64,842
Maryland	1,158	0	0	0	1,158
Michigan	205	0	0	0	205
Missouri	31,014	0	0	0	31,014
Montana	2,299	181,855	87,521	0	221,675
New Mexico	10,752	50,671	0	4	61,427
North Carolina	110	0	0	0	110
North Dakota	0	0	350,630	0	350,630
Ohio	41,358	0	0	0	41,358
Oklahoma	3,281	0	0	0	3,281
Oregon	50	284	0	0	334
Pennsylvania	56,759	0	0	20,510	77,269
Rhode Island	0	0	0	0	0
South Dakota	0	0	2,031	0	2,031
Tennessee	2,572	0	0	0	2,572
Texas	6,048	0	6,824	0	12,872
Utah	23,541[2]	180[2]	0	0	23,721[1]
Virginia	9,352	0	0	335	9,687
Washington	1,867	4,190	117	5	6,179
West Virginia	100,628	0	0	0	100,628
Wyoming	12,705	107,951	0	0	120,656
Other States	610	32	46	0	688
Total	686,033	424,073	449,519	21,362	1,580,987

[1] Small resources of lignite included under subbituminous coal.
[2] Excludes coal in beds less than 4 ft. thick.

Averitt, Paul. 1973. Coal, in United States Mineral Resources: U.S. Geological Survey, Prof. Paper 820.

Table 1-13
Demonstrated Reserve Base[1] of Coals in the United States on January 1, 1974
Potentially Minable by Underground and Surface Methods
(Million Short Tons)

State	Anthracite Under.	Anthracite Surface	Bituminous Under.	Bituminous Surface	Subbituminous Under.	Subbituminous Surface	Lignite Surface	Total
Alabama	–	–	1,798	157	–	–	1,027	2,982
Alaska	–	–	–	1,201	4,246	5,902	296	11,645
Arizona	–	–	–	–	–	350	–	350
Arkansas	96	–	306	231	–	–	32	665
Colorado	28	–	9,227	870	4,745	–	–	14,870
Georgia	–	–	1	–	–	–	–	1
Illinois	–	–	53,442	12,223	–	–	–	65,665
Indiana	–	–	8,949	1,674	–	–	–	10,623
Iowa	–	–	2,885	–	–	–	–	2,885
Kansas	–	–	–	1,388	–	–	–	1,388
Kentucky, East	–	–	9,467	3,450	–	–	–	12,917
Kentucky, West	–	–	8,720	3,904	–	–	–	12,624
Maryland	–	–	902	146	–	–	–	1,048
Michigan	–	–	118	1	–	–	–	119
Missouri	–	–	6,074	3,414	–	–	–	9,488
Montana	–	–	1,384	–	64,450	35,464	7,098	108,396
New Mexico	2	–	1,527	250	607	2,008	–	4,394
North Carolina	–	–	31	[2]	–	–	–	31
North Dakota	–	–	–	–	–	–	16,003	16,003
Ohio	–	–	17,423	3,654	–	–	–	21,077
Oklahoma	–	–	860	434	–	–	–	1,294
Oregon	–	–	–	[2]	1	[2]	–	1
Pennsylvania	7,030	90	22,789	1,091	–	–	–	31,000
South Dakota	–	–	–	–	–	–	428	428
Tennessee	–	–	667	320	–	–	–	987
Texas	–	–	–	–	–	–	3,272	3,272
Utah	–	–	3,780	262	–	–	–	4,042
Virginia	138	–	2,833	679	–	–	–	3,650
Washington	–	–	251	–	1,195	500	8	1,954
West Virginia	–	–	34,378	5,212	–	–	–	39,590
Wyoming	–	–	4,524	–	24,997	23,845	–	53,366
Total	7,294	90	192,334	40,562	100,211	68,070	28,163	436,725

[1] Includes measured and indicated categories as defined by the USBM and USGS and represents 100% of the coal inplace.
[2] Less than 1 million tons.

Source: U.S. Bureau of Mines. Demonstrated Coal Reserve Base of the United States on January 1, 1974. Bureau of Mines Mineral Industry Surveys, May 1975.

coal occurring in this topographic setting can be reached by drift mines, and even larger tonnages with overburden more than 1,000 ft thick can be reached conveniently through the same openings.

The small reserve tonnage in the Pacific Coal Province reflects the fact that in Washington most of the coal lies on the flanks of steeply dipping basins, and thus passes below 1,000 ft of overburden a short distance from the outcrops, and also the fact that in Alaska, most of the coal is classified as inferred.

COAL USES

Coal is used almost exclusively as a source of heat and power. Some coal is converted to metallurgical coke before it is used for heat.

Coal's largest and fastest growing market is the electric utility industry, which accounted for 70 percent of total bituminous coal and lignite consumption in 1974. In turn, coal at present accounts for more than 45 percent of total power generation, and 57 percent of total generation by fossil fuels. This is a result, primarily, of the relatively low cost of coal.

How long coal will maintain dominant position is subject to the interplay of many variables including reserves, availability, prices of competitive energy sources, relative efficiency in utilization, and environmental constraints. Coal's

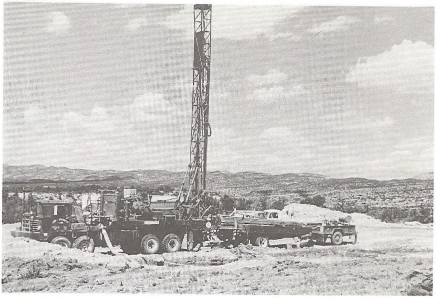
position in these several respects generally is favorable.

Next in importance to power generation by utilities is the use of coal in the primary metal industries, principally for the production of coke for use in blast furnaces of the steel industry, and for the self-generation of power at steel and rolling mills. These uses accounted for approximately 17 percent of coal consumption in 1974. Production from Federal lands is in Colorado, Utah and New Mexico. The amount of coal used for such purposes in the future will be determined by the demand for iron and steel, together with the results of new technological experimentation in reducing iron ores whereby coke requirements would be lessened.

Major future users of coal are expected to be those same industries now consuming it, but increases in consumption are projected, mainly, for generating electric power. In addition, coal will be used to manufacture synthetic gas and liquid fuels. Its use for these products should equal or exceed that used for electric power generation by the year 2000. Additional coal will be required for liquefaction. It has been projected that requirements in the year 2000 for liquefaction and gasification combined will be as high as 1,274 million tons.

Solvent refined coal (SRC) is considered to be a coal product of the future. SRC is coal from which most ash, sulfur, and moisture is removed. This product will be used by one of the coal-consuming industries. Therefore, total consumption will be increased only by the amount required for heat and power for the process.

The use of coal in the household and commercial market has declined drastically since the early 1940s, when consumption ranged around 120 million tons per year, as compared to 8.8 million tons in 1974. Direct consumption in this market is expected to continue downward on an overall basis, largely in response to shifts to other energy sources. A significant consideration in the switch to oil and natural gas in this market has been greater convenience in using these fuels. More recently, some of the direct loss for coal can be attributed to the substitution of electricity in space heating. Indirectly, however, this is not a complete loss because the decline is compensated to the extent that coal is consumed in generating electricity used for space heating.



Exploratory drilling is generally done with truck-mounted rotary rigs.

Since 1950, the use of coal in food, paper, chemical, and allied industries has been decreasing, as has its use in transportation. For many years, railroads and sea and lake vessels collectively were the largest consumers of coal (132 million tons in 1944). The railroad market virtually has disappeared and that for vessel bunkering has declined drastically.

Coal consumption in the stone, clay, and glass products industries, other than cement production, has been declining steadily. This decline has been offset, however, by increasing coal requirements at cement plants which, in 1970, accounted for about 70 percent of the coal used by the group, a percentage that is increasing.

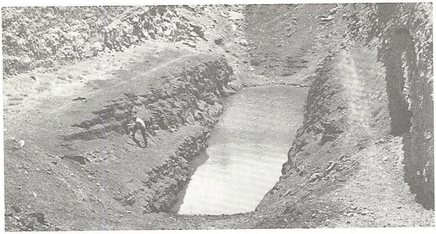
COAL MINING

Exploration, development, production, and restoration, are the four operations executed during the life of a coal mine. If the coal mined contains excessive impurities, it is cleaned before being marketed. The cleaning process is termed beneficiation.

Exploration

Exploration aims at locating the presence of economic deposits and establishing their nature, shape, and grade. The investigation may be divided into two parts, (1) preliminary or prospecting, and (2) final exploration, which often overlap. In general, locating the presence of a coal deposit is considered as preliminary exploration. Then establishing whether or not it is an economic deposit by its nature, shape (size), and grade is considered as final exploration.

An accepted method of exploration is to first search the literature to determine the geology, previous discoveries, surface and mineral ownership, and access routes in the general area. This is followed by a geologic reconnaissance to select the logical location(s) for detailed geologic study and exploratory holes. Such reconnaissance may require the use of an airplane or helicopter. After establishing the location(s) for detailed exploration, it becomes necessary to obtain permissions and permits. The procedure for obtaining a prospecting permit on Federal land for Federal minerals is described elsewhere in this report. From detailed geology and drill-hole data, the nature of the overlying strata, depth and thickness of the coal deposit, and the quantity of ground water is determined.



Occasionally, during exploration, pits or trenches are dug near coal outcrops. This pit is on Black Mesa, Arizona. Such excavations on Federal coal deposits are required to be backfilled, graded and seeded.

Analysis of samples taken from the drill hole will ascertain the grade of coal and the quality of ground water if needed. A number of exploratory holes are required to delineate the extent of the deposit and its quantity. Hole depths will range up to 300 feet deep when exploring for deposits mineable by surface methods, and to over 1,500 feet deep when underground methods are contemplated.

Air is used to remove cuttings from exploratory holes, however, sometimes fluid is required. The fluid is water with additives to give the desired properties. The additives are barite, for increasing the fluid weight, bentonite, wood fibers, shredded paper, mica fines, biodegradable synthetics, rice hulls and similar material to seal porous formations or aid in the drilling of the hole.

Exploratory drilling is generally done with truck-mounted rotary rigs, and the samples taken with such rigs can be either cuttings or core, or both. Additional equipment used by an exploration crew may include water trucks, personnel carriers, a hole-logging equipment truck, and a dozer or grader to assist in obtaining access to the exploration area and drill site. The latter is used only when terrain or vegetation will not otherwise allow travel.

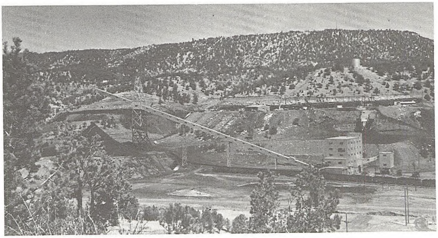
Although state regulations vary, Federal regulations require all aquifers and workable coalbed be cemented off and a concrete plug placed in the collar of the hole. Disposal of cuttings and reclamation of the drill-site is also required.

Occasionally, during exploration, pits or trenches are dug with a backhoe or dozer near the coal outcrop. On Federally owned land and/or coal deposits, regardless of how they were excavated, requirements are that excavations be backfilled and the surface graded and seeded.

When exploration terminates, all dozed or bladed trails or any other disturbed surface must be graded and seeded except some roads may be left open as specified by the surface management agency.

Development

Development, the preparatory operation to production, begins after an economic coal deposit has been found. However, it continues throughout the life of the mine. Except for planning the mine, which includes plans for mined-land reclamation and prevention of air and water pollution, actual development cannot begin until all necessary arrangements have been made with Federal, State, and local governments as well as the surface and mineral owners if privately owned. Such arrangements include obtaining a lease and requiring permits and licenses; and providing access to the mine property for roadways, railroad, and utilities; and bonding. The procedure for obtaining a Federal coal lease is described elsewhere in this section. Permits and licenses are requirements of State and local authorities. A usual requirement, in addition to a fee, is for an approved mining and reclamation plan before a permit is granted. Obtaining access to the mine property is usually the responsibility of the lessee. Bond is posted to insure payment of rents and royalties and restoration of the land as mining progresses. When a coal deposit has been mined by underground methods, restoration is the removal of all equipment and structures, grading waste piles to acceptable standards, sealing all entries to the mine, and revegetation. For a coal deposit mined by a surface method, bonding is to assure removal of all equipment and structures, and reasonable grading of the spoil followed by revegetation.



Development of a mine requires construction of access roads, utility lines, mine plants, and often a railroad spur. This is the York Canyon mine near Raton, New Mexico.

An access road is usually necessary for a new mine. This construction is in Appalachia.

Exposed strata containing toxic material are covered.

Almost all states where coal is mined by surface methods require bonding of the operator to assure reclamation of the mined land. Where such bonding is required, the amount is based upon the number of acres that will be disturbed in one year. The bond remains in force until the disturbed land is reclaimed. The amount of such State bonds is commonly greater than the amount required for mined-land restoration under a Federal lease.

Planning is the first stage of development, and for a successful operation it must include all details of how the development work is to be accomplished, the method and equipment to be used for mining, provisions for restoration of the land and prevention of air and water pollution, and a map depicting the progress of proposed mining and land reclamation. Development drilling is often done at this stage to define mine limits and mine problems.

After planning, the development of a mine includes construction of a road for access to the mine property, utility lines, a mine plant, and access to the coal deposit. Depending upon the amount of coal produced annually and where the coal is to be used, construction of a railroad spur may be required. For coal that contains excessive impurities, a washing plant could be constructed as part of the mine plant. This is usually done for large mines with impure coal, but for small mines, impure coal is generally hauled to a central washing plant.

If the coal is to be mined by underground methods, the mine plant is commonly constructed near the portal of the main drift, slope, or shaft. For coal mined by a surface method, the mine plant should be off the coal outcrop, if possible.

A mine plant will include a tipple; coal storage; office; maintenance shops; change house with showers and toilets; power substantion; laboratory; parking lot; storage building for equipment, supplies and materials; and a waste disposal area.

Mine ventilation fans are part of the surface plant at underground operations.

At an underground mine, the tipple would be constructed at the main portal, and at a surface mine, it would be so located that the maximum haul from working face to tipple will not be excessive.

Access to the coal deposits at an underground operation is provided by either drifts, slopes, or shafts (Figure 1-5). The coalbed is developed for further operations by driving entries. Although the terminology varies, the following system of entries is universal in the industry.

Main entries are extensions of the access openings and often run several miles in one direction. Three of more parallel entries, 12 to 22 ft wide and 40 to 100 ft between centers, are driven in a given direction and connected at intervals by crosscuts to provide proper air circulation. These are the major routes of underground transport and access and serve for the life of the mine.

Panel entries are driven from the main entries, resulting in a subdivision of the coalbed into blocks or panels having dimensions that may be as much as 1 by 1/2 mile. Panel entries serve as routes from main entries to the working places and for air circulation. Although coal is removed during the driving of both the main and panel entries, it is with completion of the panel entries that the production cycle begins.

Main entries must remain open for the life of the mine, and panel entries must remain open until the adjacent panels are mined. To insure their remaining open, they must be supported. Entry supports can be roof bolts, roof trusses, yieldable arches, reinforced concrete liners, and wood or steel sets. The primary mechanism used to support workings is the use of natural pillars. The frequency, type, and size of the supports depend upon

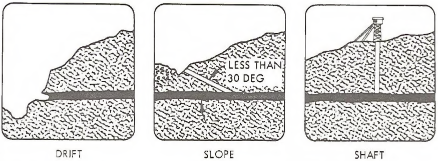


Figure 1-5. The three types of access used in underground coal mines.

the nature and condition of the overlying strata.

To comply with the Federal Coal Mine Health and Safety Act of 1969 (PL 91-173), a minimum of three entries must be driven. One for air intake, one for removal of coal, and the third for exhausting air from the mine. A roadway for men and equipment may be located in the intake air entry or coal removal entry. Although the entry used for transporting coal from the mine must be ventilated, it cannot be used as an air course.

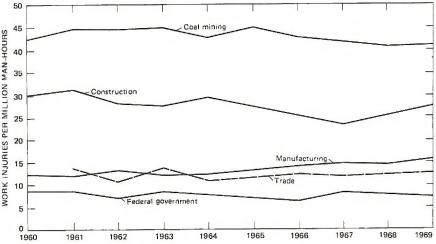
The installation of the transportation system (railroad or conveyor belt), water and compressed air lines, and electric power and telephone lines is also considered part of mine development.

Gaining access to the coalbed(s) where mining is to be accomplished by a surface method is part of the development phase. It includes construction of haul roads form the tipple to the mining area, roads from the haul roads to the working face, electric power lines from the substation to the mining area, gasoline and diesel fuel storage, and installation of portable chemical toilets near working places. It also includes the assembly of large equipment such as bucket-wheel excavators, draglines, and shovels; and removal of topsoil and the initial overburden from the coal so mining may begin. Closer spaced drilling to define mining limits or mining problems is often part of development. As mining progresses, development mainly consists of extending the haul roads and power lines and constructing new roads to provide access to the working face.

Production Methods

Production is defined as the yield or output of a mine. However, this phase or cycle depends on many factors. For a mine to succeed it must operate at a profit, and a profit cannot be made without production. But production cannot be gained at the expense of the health and safety of the miners or the health and well-being of the public. The Federal Coal Mine Health and Safety Act of 1969 (PL 91-173) was passed to protect miners, while air and water pollution and land reclamation laws are for protection of the public. In addition, esthetic values must be considered, and coal should be mined with the least possible waste of the resource. The mining methods must be such that surface improvements will not be damaged while the mine is operational or thereafter.

Since 1910, major improvement has been made in coal mine safety in the United States, but subsurface coal mining is still the most hazardous of all industries, as shown for a nine-year period in Figure 1-6.



Source: Bureau of Labor Statistics, Report 389.

Figure 1-6. Work injuries for all industries for a nine year period, 1960-1969.

1. Based on work injuries, subsurface coal mining is one and one-half times more hazardous than the construction industry and three times more hazardous than manufacturing.

2. On the average, subsurface coal miners who install roof bolts have a serious accident every 2-1/2 years and lose 54 working days per lost-time accident.

3. In subsurface coal mining, the death rate from respiratory disease is five times the industrial average.

4. Subsurface coal mining has eight times the average incidence of occupational respiratory diseases.

Information on all injuries incurred in subsurface coal mining were collected and compiled by the Bureau of Mines until 1970. The statistics developed from these data were originally published in Bulletins, later in Technical Papers, and now annually in Information Circulars. Figures 1-7, through 1-10 were developed from data published in the Information Circulars for the period 1960 to 1970. It may be noted that the number of subsurface injuries, fatal and nonfatal, per million manhours worked shows little if any, improvement. While the injuries per million short tons of coal produced have decreased because of improved production technology, Figures 1-7 through 1-10 also show that when injuries per million man-hours worked in underground mines are separated from those of surface operations and the number of injuries incurred in surface mining is reported separately from strip and auger mining, the frequency of strip-mining injuries is comparable to the frequency of injuries that have occurred in the construction industry. Records show that health and safety problems are far more severe in underground mines than in surface operations. Enactment of Public Law 91-173 was for the purpose of improving coal mine health and safety. The act cites requirements and authorizes appropriation of funds for three necessary elements of a balanced attack on the problem:

1. Comprehensive enforcement of existing and new mandatory health and safety standards.

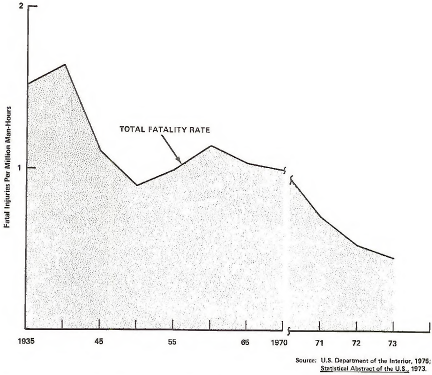


Figure 1-7. Fatal Injuries, U.S. Coal Mining, 1935-73.

YEAR	UNDERGROUND		SURFACE		MECHANICAL CLEANING PLANTS		TOTAL	
	NUMBER	RATE[1]	NUMBER	RATE[1]	NUMBER	RATE[1]	NUMBER	RATE[1]
1935	1,216	1.52	26	1.37	NA	NA	1,242	1.52
1940	1,361	1.68	27	.94	NA	NA	1,388	1.65
1945	1,029	1.16	39	.55	NA	NA	1,068	1.11
1950	602	.94	41	.56	NA	NA	643	.90
1955	391	1.06	29	.56	NA	NA	420	1.00
1960	295	1.29	28	0.57	2	0.48	325	1.15
1965	240	1.21	19	.39	–	–	259	1.04
1970	220	1.20	33	.58	7	.36	260	1.00
1971	149	.86	26	.41	6	.34	181	.71
1972	127	.60	21	.35	8	.39	156	.53
1973	107	.49	17	.28	8	.38	132	.44

[1]Per million man-hours.

Figure 1-8. Fatal Injuries, U.S. Coal Mining, 1935-73.

A cutting machine in an Appalachian mine.

2. Expanded and upgraded health and safety education and training activities and technical assistance to mine operators.

3. A balanced program of research and technical support to build a mining technology that will bring long-lasting health and safety improvements.

Each of these elements reinforces the others; each works to produce improvements in both the long and short term. Together, they offer hope for improving coal mine health and safety.

Underground Mining. In underground mining after the initial development has gained access to the coalbed, one of three methods, room-and-pillar, longwall, and shortwall, are commonly used to extract the coal. Regardless of the underground mining method used, surface subsidence generally will result. It can occur immediately after the coal is removed or at any time thereafter. It has been known to occur as long as 50 years after coal was mined. The degree of subsidence is generally governed by the depth of the mine and the amount of coal left for support.

Room-and-Pillar Mining. Room-and-pillar mining has been used in the United States longer than any other underground method. Mining is accomplished by driving entries off the panel entries. As mining advances, rooms are excavated in the coal seam, and the strata above supported by pillars of coal left in place. Then, after a block, panel, or section has been mined, part of the coal in the pillars can be recovered as a retreat is made toward a main entry. Until about 1950 most of the coal produced from underground mines was by the conventional technique. Since then, conventional mining gradually has been replaced bv more mechanized, continuous mining. Figure 1-11 illustrates the basics of both techniques.

Conventional mining requires driving a number of entries so that each operational phase, undercutting, drilling, placing explosives, blasting, loading the shot coal, and roof bolting, can be done simultaneously without

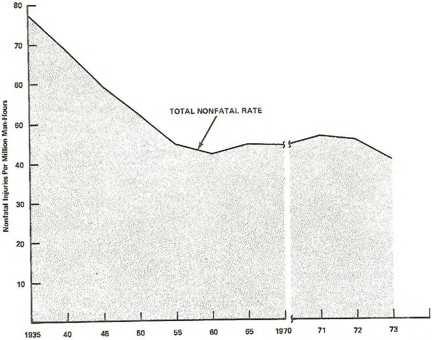


Figure 1-9. Non-Fatal Injuries in U.S. Coal Mining, 1935-73.

Source: U.S. Department of the Interior, 1975; Statistical Abstract of the U.S., 1973.

YEAR	UNDERGROUND		SURFACE		MECHANICAL CLEANING PLANTS		TOTAL	
	NUMBER	RATE[1]	NUMBER	RATE[1]	NUMBER	RATE[1]	NUMBER	RATE[1]
1935	62,121	77.63	1,305	68.86	NA	NA	63,426	77.43
1940	56,257	69.32	1,519	52.67	NA	NA	67,776	68.75
1945	54,278	61.17	2,839	39.83	NA	NA	57,117	59.58
1950	34,986	54.77	2,278	31.39	NA	NA	37,264	52.38
1955	17,699	48.10	1,186	23.07	NA	NA	18,885	45.03
1960	10,520	46.09	1,217	24.81	165	39.19	11,902	42.28
1965	9,705	49.09	1,271	26.39	162	51.62	11,138	44.73
1970	9,531	51.79	1,458	25.60	563	29.34	11,552	44.40
1971	9,766	56.40	1,700	26.81	460	25.96	11,916	46.89
1972	10,790	56.84	1,155	20.41	387	17.80	12,332	45.67
1973	9,466	49.04	1,161	19.80	440	19.49	11,067	40.42

[1]Per million man-hours.

Figure 1-10. Non-Fatal Injuries in U.S. Coal Mining, 1935-73.

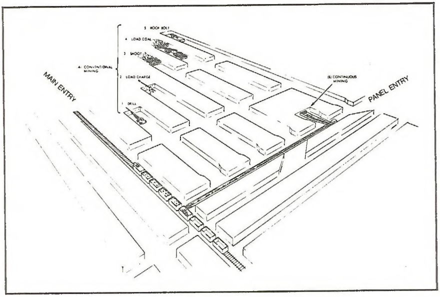
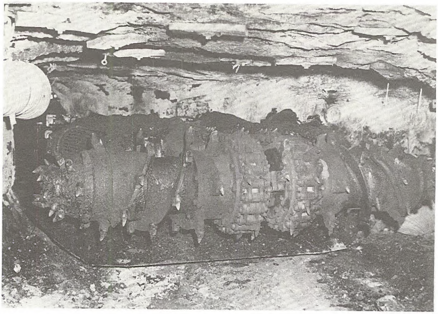


Figure 1-11. Room-and-pillar mining techniques.

one phase of the operation interfering with another.

Continuous mining is performed by electric-powered machines that either bore, dig, or rip the coal from the working face. Such machines are usually crawler-type vehicles operated by one man. They either load the coal into a shuttle car or pile it behind the machine. When coal is piled behind the machine, a mechanical loader is used to load the shuttle cars. Continuous operation of a mining machine cannot be achieved, however, because stops are required to support the roof, await haulage equipment, advance power and water supply, change cutting bits, etc. Hence, the effective duty cycle is reduced to approximately 20 percent. A mining machine, on an average, can cut 500 to 600 tons of coal per shift. All machines are equipped with detectors that automatically stop the machine when a concentration of gas becomes excessive and with water sprays that suppress the dust.

Where the entire thickness of the coal seam is mined, recovery averages about 50 percent nationwide. However, it is not always possible to take the entire coal seam thickness, because it often is necessary to leave part of it for roof support. Coal is left as roof support where the overlying strata is too weak to stand alone or to reduce pillar failure, which increases with increases in the height of the pillars. The latter is a common practice in seams greater than ten feet in thickness. Roof bolts and timber are used for additional support. None of the foregoing will entirely prevent subsidence. Depending on conditions, the effects of subsidence may not be noticeable at the surface. Where coal is mined by advance mining alone, the surface at some time in the future may subside as the roof collapses into the rooms. This type of subsidence can be dangerous for there have been instances when men and animals have fallen in as the surface subsided and were killed or injured. An additional hazard is the loss of a potential resource by fire. Subsidence may allow air to reach the coal seam which can activate the coal to the point of combustion. Once a fire has started, it continues to burn until caving, induced by man or nature, prevents air



Continuous mining is performed by electric-powered machines that extract the coal from the working face.

from entering, or until the fire reaches the limit of coal or a fault in the coal seam. Displacement of the seam at the fault must exceed the coal seam thickness to prevent the fire from continuing. Severity of both surface subsidence and coal fire hazard decreases as the depth of mining increases.

Where subsidence of the ground above is permissible, the coal pillars are removed when retreating, which allows the roof to collapse after the mining operation. Drainage of surface water collecting in the subsidence may enter the mine and create a potential for flooding the mine or polluting ground water. Where all of the pillars in the panel area can be recovered, the surface over the panel should subside uniformly. Manually, or mechanically operated props are used to support the roof adjacent to the pillars. Then as the pillars are recovered, the props are moved in the direction of retreat. Retreat mining permits greater recovery of the resource, lessens the potential of fire in the remaining coal, and generally provides a greater area of uniformity in the subsided surface.

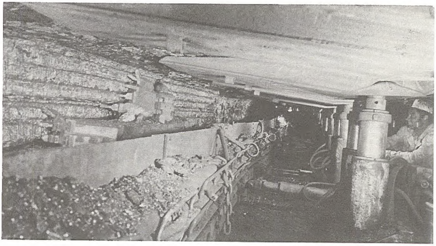
Longwall. Contemporary longwall mining, first introduced to the United States in the 1950's, has long been practiced extensively in European mines. To support the roof at the face, longwall mining originally used manually operated props, then gradually evolved to the presently used powered, self-advancing supports. Longwall mining is used most efficiently in uniform coal seams of medium height (42 to 60 in.). The lower limitation is attributable to the minimum height of currently available self-advancing roof supports. However, 30-in. seams are mined by the longwall method in Wales.

As in the room-and-pillar method, longwall mining starts with sets of entries cut into the panel areas. The difference in the technique lies in the seam (i.e., panel) length between these sets of entries and the method used to extract intervening coal. Longwall blocks range from 300 to 600 ft wide and are sometimes 1-1/2 mi. long (Figure 1-12). The longwall machine (Figure 1-13) laterally shears or plows coal from the entire face, transports the fallen coal by an advancing conveyor to a secondary haulage conveyor, reverses direction at the end of a cut, and supports the roof in the area of the face by a self-advancing system of hydraulic jacks. The roof is allowed to cave behind the advancing work area; the roof is occasionally blasted to insure a controlled cave-in rate and to reduce overburden pressure on the coalbed being mined.

Surface subsidence from longwall mining should be generally uniform over the panels and will occur as mining progresses. Surface subsidence over the entries, however, will not occur until some time after mining has been finished.

Shortwall. The shortwall method of mining coal, a relatively new innovation, is best described as a method similar to longwall mining with two exceptions. The blocks of panels are smaller, usually ranging from 100 to 150 ft wide and 300 to 500 ft long, and the coal is cut with a continuous miner and is loaded into shuttle cars.

Surface subsidence will be irregular with depressions over the panels occurring as mining progresses. The natural surface should remain over the



Plow-type longwall mining system as used in northern West Virginia mines. The plow ranges back and forth along the seam for a distance of as much as 400 feet.

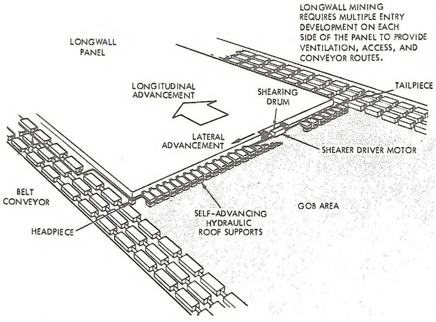


Figure 1-12. Longwall mining.

entries until after completion of mining. If the entry supports give way, surface subsidence will begin over and along the entries.

Surface Mining. Strip and auger mining are the two most common surface methods of extracting coal in the United States. In the eastern United States, auger mining is used on hillside terrain. It requires a surface cut (removal of overburden and coal beds) to allow the auger access to the bed. It is often used to recover part of the crop coal left from underground mining. In the western United States, auger mining is being tried as a means of recovering coal at strip mines where the overburden depth exceeds economic limits. Two other methods, open-pit and quarry-type mining, are being tried in thick, shallow-lying western coal seams and may become generally accepted where conditions warrant their use.

Regardless of the method used, rehabilitation of the mined land is essential and must be pre-planned as an integral part of the mining process. The cost of grading and revegetating the mined land to a terrain that is ecologically suitable, economically and otherwise acceptable, and planned for future usefulness must be borne by the coal consumer. Incorporating rehabilitation into the mining plan at the time of development means that better rehabilitation of the land will result at a savings in cost. Mined-land rehabilitation should be kept as closely abreast of coal removal as possible.

At most surface mines, topsoil affords the best surface material for plant growth. It should be removed and stockpiled before mining begins. Then it can be replaced after the spoil has been graded. Areas having no suitable topsoil require analysis of the material overlying the coal so that specific requirements can be developed for segregating, placing, and improving the material to be left as new surface.

Strip Mining. Strip mining is accomplished by two techniques, area stripping and contour stripping. Where coalbeds are relatively flat and near the surface, as in much of the west, area stripping is the dominant technique.

In area strip mining, overlying material (overburden) is removed from a seam of coal in long narrow parallel bands, or strips, followed by removal of the exposed coal. With the exception of the first cut (box cut), overburden from each cut is discarded in the previous cut from which the coal has been removed. These parallel cuts continue across the coal seam until the thickness of the overburden becomes too great to be removed economically or until the end of the coal seam or property is reached. Figure 1-14 depicts a cross-section and plan view of a portion of a strip coal

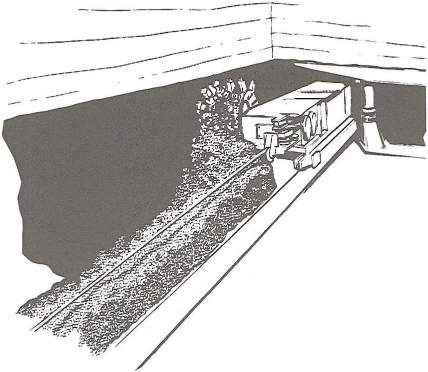


Figure 1-13. Continuous mining machine.

mine. Both single and multiple seams, near the surface, can be mined in this manner.

Overburden removal can be accomplished with almost any kind of earth-moving equipment, but bucket-wheel excavators, draglines, and shovels are the three kinds of equipment used at the large area-stripping operations. Bucket-wheel excavators are used extensively in Europe, but in the United States, the dominant machines for overburden removal are draglines and shovels. This is not strictly a matter of preference, but results from the nature of the overburden material. A bucket-wheel excavator will not work efficiently in rock even after drilling and blasting. In the United States much of the overburden contains layers of shale, limestone, or sandstone that must be drilled and blasted before it can be removed. Draglines and shovels are more efficient in these materials than a bucket-wheel excavator.

One difference between removing overburden with a dragline or a shovel is the place from which it operates. A dragline operates from atop the cut, while a shovel removes the overburden with its crawlers resting atop the coalbed. In the large mines operating in the United States, bucket capacities of both draglines and shovels will average about 50 cubic yards. Some of the larger bucket capacities exceed 200 cubic yards.

After the overburden is removed, coal is usually drilled and blasted. Then it is loaded into coal haulers with either a shovel or a front-end loader. Bucket capacities of coal-loading shovels and front-end loaders commonly range from 10 to 20 tons, and coal haulers range in capacity from 40 to 200 tons.

Contour stripping is practiced on steep terrain, mostly in the Appalachian region. The method consists of removing overburden from the coalbed with the first cut at or near the outcrop and proceeding around the hillside. The cut appears as a contour line, thus the name. Overburden is cast down the hillside and stacked along the outer edge of the bench. After the uncovered bed is removed, successive cuts, usually only two or three, are made until the depth of the overburden becomes too great for economical recovery of the coal. Contour mining creates a shelf or bench on the side of the hill. On the inside it is bordered by the highwall, ranging in height from a few feet or more than 100 ft and on the outer side by a high ridge of spoil with a precipitous downslope which is subject to erosion and landslides.

In the late 1960s, modifications to eliminate or reduce erosion and landslides began. Although refinements are still being made for varying conditions, the modified methods are proving to be successful. The various modifications have been named: slope reduction methods (7°-storage angle), slope reduction method (parallel fill), pit-storage method, box-cut method (two-cut), and head-of-the-hollow fill method.

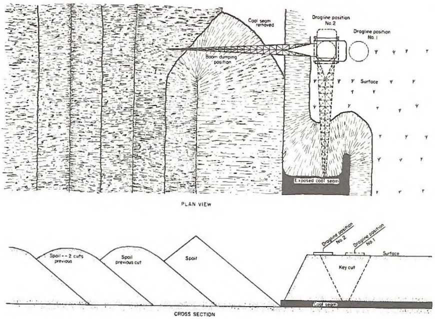


Figure 1-14. Cross-section and plan view of a portion of a strip coal mine.

In area strip mining, overlying material (overburden) is removed from a seam of coal in long narrow parallel bands or strips, followed by removal of the exposed coal. This is the Big Sky Mine near Colstrip, Montana.

The slope reduction methods, both the 7°-storage angle and the parallel fill, were developed on the theory that by reducing the weight on the fill bench and spreading the spoil over a large area it would be less likely to slide. The procedure used to recover the coal and rehabilitate the land by the slope reduction method (7°-storage angle), is described in Figures 1-15 through 1-17 (from Grim and Hill, 1972).

The slope reduction method (parallel fill) is a modification of the slope reduction method (7°-storage angle). Overburden is pushed down the slope and compacted in 3-ft layers at the same angle as the original slope. The depth of the fill is determined according to the degree of original slope. Although parallel fill is still in the experimental stage, it may prove to be more successful than the storage angle method, because slides have not occurred where it has been tried.

When the pit storage method is used, a block of overburden is removed and disposed of by one of the slope reduction methods. This original cut is made into the hillside to the maximum width that is to be contour mined. The length, along the hillside, is generally three times as long as that of the following cuts. After the coal is removed, the overburden from the second cut is placed in the first pit and the coal from the second cut is removed. This process is repeated as mining progresses around the mountain. Once the original cut has been made, mining can be continuous, working in both directions from cut number one if the operator so desires. This method places little overburden on the original slope and allows the operator to mine a maximum width bench with maximum coal recovery. Grading to the approximate original contour is thus cheaper, and the potential for slides is minimized.

In the box-cut method (two-cut), a box-cut is created in three steps. Its procedure, including grading the disturbed land for rehabilitation, is illustrated in Figures 1-18 through 1-21 (from Grim and Hill, 1972).

The head-of-the-hollow fill method was developed to improve esthetics and reduce landslides. It can be used for full recovery of one or more coal seams and to produce rolling mountaintop land that is suitable for multiple use. Spoil storage space is provided for in narrow "V" shaped steep-sided hollows, near the ridge top, that are free of underground mine

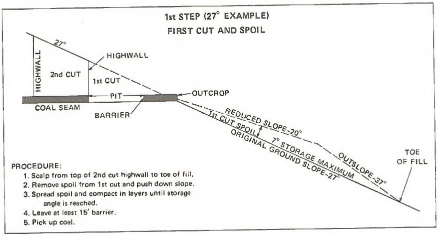


Figure 1-15. First step (27° example) first cut and spoil.

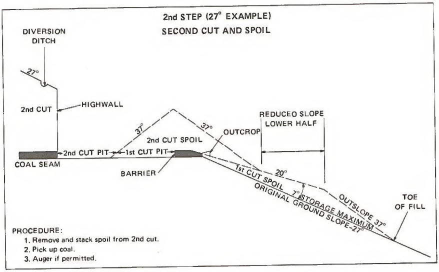


Figure 1-16. Second step (27° example) second cut and spoil.

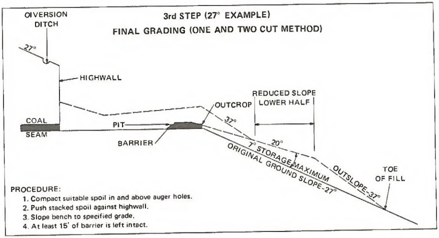


Figure 1-17. Third step (27° example) Final grading (one and two cut method).

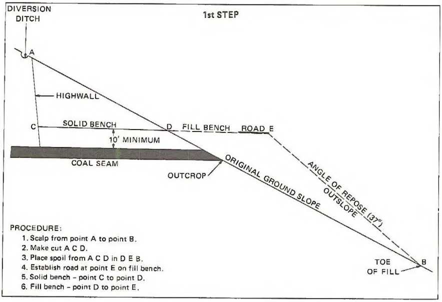


Figure 1-18. First step box-cut method (two-cut).

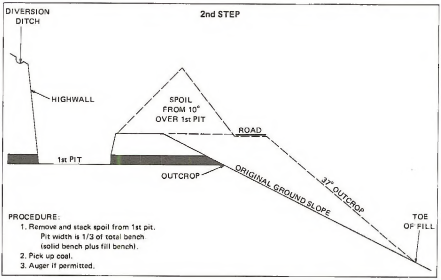


Figure 1-19. Second step box-cut method (two-cut).

Contour mining in the Appalachian Region.

openings or wet weather springs. The size of the selected hollow must be such that the overburden generated by the mining operation will completely fill it. The procedure for placing the spoil in the hollow is:

1. Scalp entire area that will be covered with fill.
2. Construct french drains in the hollow water courses.
3. Build the fill in compacted layers; face of fill no steeper than 2:1.
4. Construct crowned terraces every 20 ft, approximately 20 ft wide.
5. Center of complete fill bench is crowned toward the highwall so that water will flow onto excavated benches.
6. Build silt control structures below hollow fill.

For greater detail on these modified methods for contour stripping, see "Surface Mining Methods and Techniques" (Grim and Hill, 1972).

Equipment commonly used for contour stripping is smaller in size and load capacity than that used for area stripping. Dozer and front-end loaders are often used for overburden removal at these operations.

Auger. Coal mining by the auger method comprises boring horizontal or near horizontal holes in an exposed face of coal and loading the coal removed by the auger. Three choices of auger heads, single, dual or triple, are available to remove up to 90 in. of coal for a distance of over 200 ft. Average depth is about 160 ft. Augering is generally used to supplement recovery at contour or strip mines when the overburden thickness becomes too great to be economically removed. It is also used where the terrain is too steep for overburden removal and recovery by underground methods would be impractical or unsafe. In this latter situation, a bench, wide enough for operating the auger and transporting mined coal, is cut around the hillside at the outcrop. Augering is considered by some to be a method of recovering part of a coal seam that, once left in place, otherwise may never be recovered. From this standpoint, auger mining also can be used (1) to recover coal between abandoned underground mines and adjacent strip mines, (2) in areas where a weak roof would prevent

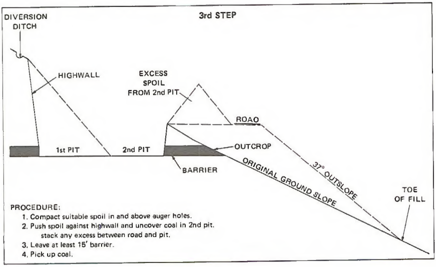


Figure 1-20. Third step box-cut method (two-cut).

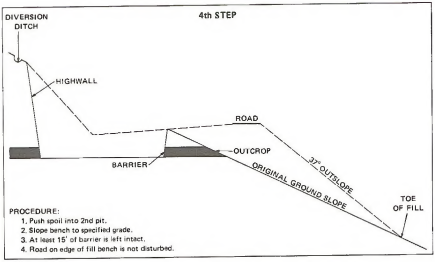
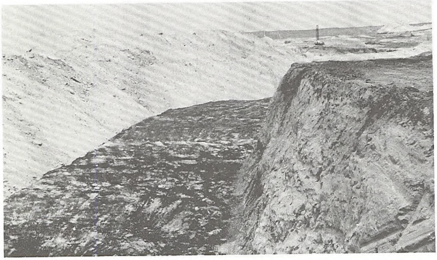


Figure 1-21. Fourth step box-cut method (two-cut).



The exposed surface of the coal seam is shown at Pacific Power's Dave Johnson mine near Glenrock, Wyoming.

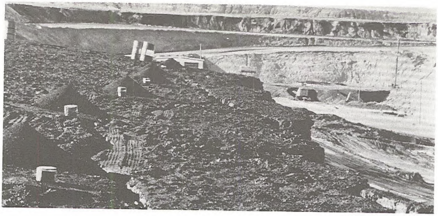
underground mining, and (3) where a thick overlying sandstone would necessitate difficult and expensive drilling and blasting if strip or contour mining were used.

Rehabilitation of auger-mined land should be accomplished by sealing the auger holes with an impervious material; then covering the coal seam and any toxic material in the highwall with the spoil generated in gaining access to the coal seam. Grading the spoil for drainage and revegetation should be done in the same manner as it is for contour stripping, or if the augering was into a highwall at an area stripping operation, grading should follow that plan.

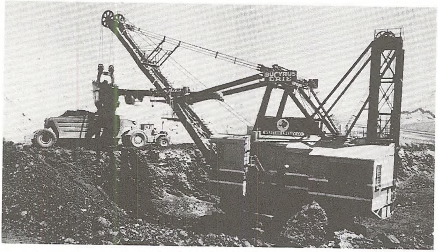
In open-pit mining, overburden is removed and placed outside the mining area. The pit increases in size and depth as mining progresses, and it is unusual that the overburden, once removed, is ever returned to the pit. It is used extensively for mining ores of copper and iron, and sand and gravel. It is used also, but not as extensively, to recover other metallic ores and nonmetals. Its use in coal mining is being tried where numerous pitching seams lie parallel to each other and outcrop on a relatively flat terrain. The overburden, the noncombustible material over and between the coal seams, can be removed with either scrapers or shovels loading into trucks. Coal is loaded into coal haulers and taken to the tipple.

Spoil from open-pit mining can be rehabilitated the same as that from strip mining. Within the pit however, land rehabilitation cannot begin until mining has been completed. Then, methods similar to those used for quarry rehabilitation will be required. Although most soil organisms are destroyed when topsoil is stockpiled over a long period of time, it should be removed from the proposed pit area and that area where spoil will be deposited. It can then be spread upon the graded spoil, and the remainder can be used to assist revegetation of the pit after mining has been completed.

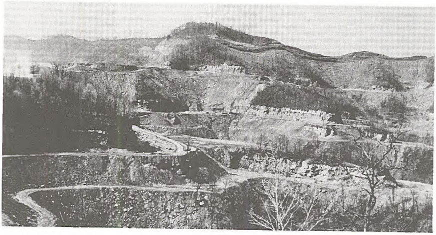
Quarry-Type Mining. Quarry-type mining, so named by Amax Coal Company because the coal is benched to facilitate its removal, is being used



At the Wyodak mine near Gillette, Wyoming the coalbed is over 70 feet thick. At center foreground the coal has been blasted and is ready to load. At left are the cuttings from holes, covered with barrels, and ready for loading the next explosive charge.



Following blasting, this shovel is loading coal at the Western Energy Mine near Colstrip, Montana.



Contour stripping is often practiced on the steep Appalachian terrain.

to recover coal that averages over 60 ft in thickness. It is a variation of strip mining for thick coalbeds. It first requires dividing the mine area into tracts, for example, 40-acre tracts. In preparation for the initial or box-cut, overburden is removed from two tracts, away from the outcrop, with shovel and trucks and spoiled (piled) on land toward the outcrop that will be mined later. Eighty acres of spoil will have to be handled twice, but when mining is completed, land that did not produce coal will not have been disturbed. When overburden is removed from a third tract, enough of the thick coal seams will have been mined from the first tract to allow spoiling in the first tract. Overburden spoiled in the mined-out pit is graded to the approximate relief of the land before it was mined so when mining terminates, the mined area will have an appearance similar to that before mining started, but lower in elevation.

Where this quarry-type mining is being done, plans call for spoil to be graded so a lake will form in the lower part of the mined area. However, should the formation of a lake be undesirable, grading can be planned so the entire mined area will drain. Revegetation of the graded plots would be the same as revegetating graded spoil at a stripping operation.

Typical equipment used for both overburden and coal removal is an 18-24 cu. yd. shovel with 65-120 ton dump trucks.

Table 1-14 shows the number of acres that would be stripped of overburden each year from a coal deposit to expose the required tonnage to be mined. In actual practice stripping is six months or more ahead of mining. This allows a safeguard in the event of a major breakdown in the overburden removal equipment. This is the primary disturbance and does not include the total area which may be twice as great.

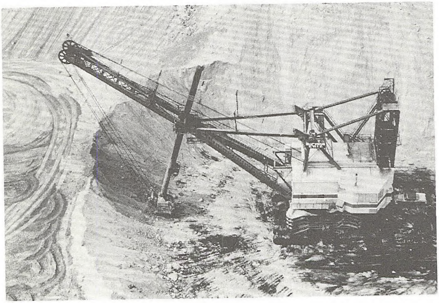
Potential Extractive Techniques. Experimentation is proceeding on several new techniques for coal removal or deriving energy from coal. Although none of the techniques has advanced sufficiently to be used for producing coal or its energy, they should be considered as potential means for future production.

These techniques may be categorized according to the form in which the energy in the coal is brought to the surface as solid, liquid, gas, or other.

Table 1-14
Relationship of Coal Thickness to Production

Thickness In Feet	Tons of Coal* Per Acre	Annual Production	No. of Acres Stripped/Yr. @ 90 Recovery
10	17,500	500,000	31.75
		1,000,000	63.49
		2,000,000	126.98
		5,000,000	317.46
15	26,250	500,000	21.16
		1,000,000	42.33
		2,000,000	84.66
		5,000,000	211.64
20	35,000	500,000	15.87
		1,000,000	31.75
		2,000,000	63.49
		5,000,000	158.73
30	52,500	500,000	10.58
		1,000,000	21.16
		2,000,000	42.33
		5,000,000	105.82
50	87,500	500,000	6.35
		1,000,000	12.70
		2,000,000	25.40
		5,000,000	63.49
75	131,250	500,000	4.23
		1,000,000	8.46
		2,000,000	16.93
		5,000,000	42.33

*Calculated on the basis of 1,750 tons per acre foot.



The giant electrically powered shovel is removing overburden at Western Energy mine near Colstrip, Montana.

Solid. One way to bring coal energy to the surface in the form of a solid would be to automate conventional underground coal mining practices so that the coal could be mined by remotely controlled mining equipment. Industry and government have developed techniques for coal mining and for other industries that would seem to be adaptable to a completely automated underground mining system. Another way would be to fracture the coal seams hydraulically and flush the solid coal to the surface. With both of these techniques, the coal would be brought to the surface in its natural form, that is, with its ash and sulfur content intact.

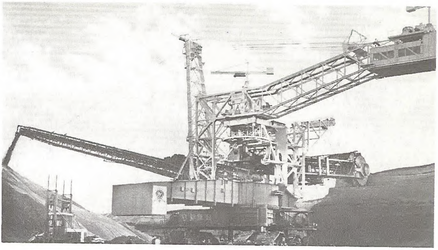
A theoretically possible alternative is the production of a fine ash-free and sulfur-free carbon powder that could easily be transported to markets and would burn without emitting any pollutants. This technique involves underground gasification, using a mixture of oxygen and carbon dioxide as the gasifying agent. At the surface, after particulate and sulfur removal, the high carbon monoxide content of the product gases would be reverted to carbon dioxide and carbon. Part of the carbon dioxide would be recycled to the gasifying agent, and the remainder vented to compensate for the oxygen input to the system. This could be utilized in thick coal seams and possibly at great depths.

Liquid. One possible technique of recovering coal in liquid form would be to heat it underground in the absence of air to liberate its volatile combustible liquids and gases. Then pyrolysis could be achieved by driving boreholes into the coal seam, linking them electrically, and passing an electric current through the seam. The passage of the current causes heat, which in turn causes distillation. Although patents have been issued (and operations proposed) for the in situ distillation of carbonaceous materials in general, the methods involve the construction below ground of processing facilities adjacent to the coalbed. The distillation equipment can involve personnel working below ground.

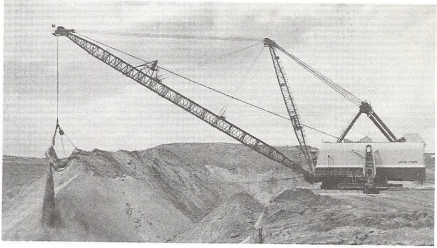
Another technique would be to dissolve the coal in certain organic solvents, a technique that is well-known and has been widely investigated. Using organic solvents, essentially anthracene-rich coal-tar fractions, one could recover the coal in a liquid form by using a process analogous to the Frasch process for the recovery of sulfur. The solvents could be injected into the coal seam through boreholes, which then could be used as passages through which the liquefied coal could be brought to the surface. The temperatures of operation would be high. In the 800°F range, a hydrogen atmosphere would be required. Some means would therefore have to be provided to maintain the high temperatures without degrading the reducing atmosphere required for the solution process. Subsidence of the surface would probably occur in this process, in a poorly controlled fashion.

Gasification. One technique for in situ extraction of the coal's energy in the form of a gas would be to force hydrogen into the coal seam under conditions suitable for transforming the carbon content of the coal directly (by hydrogenation), into methane, the basic component of pipeline gas. The reaction is highly exothermic. To achieve reasonable yields it must be carried out at high pressure, while to achieve reasonable reaction rates it must be carried out at temperature levels above 1700°F.

The alternative route to the production of a gaseous fuel from coal is through oxidation of the carbon content to carbon monoxide associated with elemental hydrogen. This partial oxidation approach, perhaps the simplest way to achieve gasification, has been the basis of essentially the entire research in this technique. It is commonly referred to as in situ combustion or underground gasification of coal. Experimental work on this alternative was done in Belgium, England, France, Italy, and the United States during a period from about 1945 to about 1960. In the USSR, experimentation started about 1933 and the work reached the stage where the extracted gas was used for generation of electricity. In the late 1960s, it was apparently stopped, because since then nothing has been

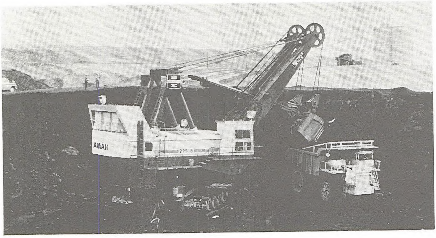


This Lauchhammer Mining Wheel, owned by the Consolidated Coal Company, is ten stories high. It removes overburden in Illinois at the rate of 1,800 cubic yards an hour.

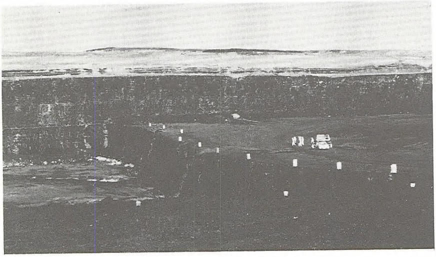


The 40 cubic yard bucket of this dragline is removing overburden at the Dave Johnson mine in Converse County, Wyoming.

Auger mining comprises boring holes in an exposed face of coal.



Quarry-type mining at the Amax Coal Company near Gillette, Wyoming.



The 70 to 90 feet thick coalbed at the south pit at the Wyodak mine is mined on two benches to remove a portion about 3 feet thick near the center of the bed.

published, and requests for information have been ignored.

In late 1972, the Bureau of Mines, again began experimenting with underground gasification in Carbon County, Wyoming. Insufficient time has elapsed to determine its success, but the following brief description of the experiment shows the principle involved in underground gasification of coal.

To start the experiment, a circle 400 ft in diameter was laid out on the surface. Initially four vertical holes were drilled; one in the center of the circle, and three on the perimeter of the northeast quadrant. The holes penetrated 400 feet of overburden and a 30-foot coal seam. Two of the holes' were fitted with deep water pumps to dewater the area. Then air was injected into the center hole to determine if there was a flow path to the other holes. A slight flow path was detected toward two of the holes. To increase the flow path a liquid under pressure was pumped into the hole at the zone of the flow path. This hydraulic fracturing is used in the oil industry for the same purpose. There was no breakdown of the formation, but four fractures were determined; one on the southwest quadrant, the major fracture; two in the northwest quadrant; and one on the southeast quadrant. After fracturing, three additional holes were drilled in the southwest quadrant; one 75 feet from the center hole and the other two 25 feet to its right and left. The center hole was then fired and air was injected. This is called forward firing. If air were injected into the perimeter holes it would be reverse firing. In earlier experiments oxygen was injected and will probably be tried here. Some gas has been recovered from the perimeter holes, but the results are inconclusive.

Other Energy Forms. The coal could be completely oxidized by a synthetic geothermal steam approach to produce combustion gases and steam at high pressures. These high pressure gases could be utilized at the surface to run the turbines of electric powerplants.

Facilities for potential extractive techniques will require extensive surface use. In addition the surface above the extracted coal will subside. The contour of the subsided surface will depend upon factors such as the thickness of coalbed (s), depth of coal, and the overlying formations. Rehabilitation of the land will depend upon how the subsidence affects the surface. It is uncertain how subsidence will affect any aquifers that overlie the coalbeds.

Beneficiation

Crushing and cleaning of mine-run coal is commonly referred to as beneficiation or preparation. Often crushing and sizing is all that is required, but many coal seams, especially those in Eastern and Midwestern States, contain enough impurities to necessitate further cleaning. Impurities in coal are innumerable, but those occurring in quantity, such as clay, rock, shale, and pyrite, require removal. Processes vary from simple to complex. The simplest are crushing and screening, which remove large pieces of foreign material, and usually are done with a breaker. Beyond this, whether the process is wet or dry, it is commonly referred to as washing.

Air Washing. Modern coal washing with air has advanced from merely blowing the dust from coal to using pulsating air to separate the coal and largely eliminating the need for close screen sizing. A survey revealed that all air-cleaning machines used in 1966 depended on pulsating air as a medium of concentration, and pneumatic jigs using such a pulsating air current have proven the most effective. Such machines have an inherent advantage in that they do not contribute to stream pollution and to thermal or chemical pollution of the air. Air pollution is virtually nil because the modern plants are completely enclosed, confining all dust to the plant. In addition, coal-washing plants must comply with PL 91-173, which requires suppression of dust within the plant.

Although not all coals can be beneficiated by air washing, it can be advantageous for those coals that are easy to clean. Of all the preparation methods, pneumatic cleaning is the most acceptable from the standpoint of delivered BTU cost. This conclusion is based on the premise that a percent of moisture is as detrimental as a percent of ash.

Wet Washing. Wet washing of coal is accomplished by floating the coal and sinking the impurities in water. The specific gravity of coal, however, is about 1.3 whereas water is 1.0; therefore, washing plants must use dissolved salts or a finely ground solid or upward currents induced into the medium to separate coal from the impurities. Wet washing, as do other processes, starts with breaking and screening the coal to remove hard large pieces of impurities. Then, the requirements for additional cleaning depend upon the amount, size, and type of impurity, how it is dispersed in the coal, and how the coal is to be used. Equipment can include any or all of the following: jigs, screens, launders, heavy medium cyclones, tricone separators, concentrating tables, froth flotation cells, filters, and driers.

Figure 1-22 is a flowsheet illustrating how this equipment is used in a modern coal preparation plant.

By the nature of the process, most of the dust is suppressed, but thermal drying of the washed coal can emit particulates that will cause air pollution if not contained by a filter or precipitator. Water used in the wet process is a potential source of stream

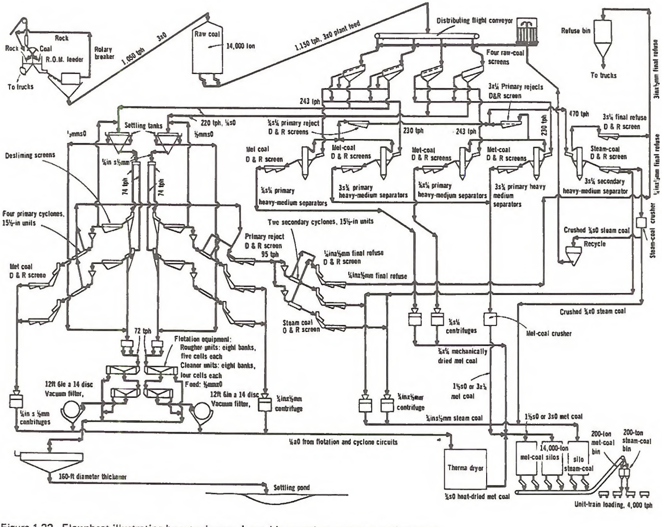


Figure 1-22. Flowsheet illustrating how equipment is used in a modern coal preparation plant.

pollution. However, modern plants use closed circuits to prevent any of the medium from escaping into water courses. Makeup water is required only in quantities sufficient to replace the evaporation losses.

Whether the process is dry or wet, refuse is produced that requires disposal. Depending upon the amount of impurities in the raw coal, refuse quantities will range from almost zero to 25 percent of the total raw coal processed. Coarse waste commonly is hauled to a disposal area by truck, and fine waste is slurried to a settling pond. Several methods of refuse disposal are acceptable, but waste containing toxic material must be disposed of in a manner to prevent contamination of surface and ground water.

One acceptable method of preventing toxic refuse from contaminating water is to return the waste to the mine, if feasible. (However, for coal produced by underground methods returning refuse to old workings can be costly, and sometimes impossible.) If the refuse cannot be returned to the mine, it should be buried to prevent its oxidation, hence prevent it from polluting any water, or catching on fire. Settling ponds for fine-wet refuse that contains toxic material should be lined with an impervious material, such as an impervious clay. Settling pond sites sometimes may be found that are naturally impervious, but no site for a settling pond should be selected where it would be subject to flooding. When a settling pond becomes filled, surface water should be removed, and the surface of the waste covered with non-toxic material. Topsoil, when available, should be used for the top layer of cover if its future use requires revegetation.

Site Rehabilitation

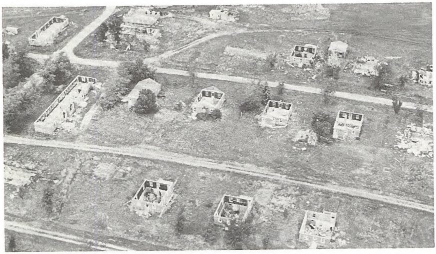
Three types of sites – underground, surface, and preparation plants – must be considered when describing site rehabilitation. No industrial operation can restore a site to exactly the condition that existed before the operation began. Therefore, rehabilitation of the site consists of making it safe, acceptable in appearance, and available for other uses, including improved uses according to plan.

Too often in the past, when a coal operation ceased, equipment of value was removed and the site was virtually abandoned. That practice is no longer acceptable. Federal coal leases require rehabilitation of mines and plant sites. Most states have mined-land reclamation laws that require rehabilitation of private lands where coal has been mined.

Section 5 of the Federal coal lease and 43 CFR 23 gives the mining supervisor or his agent the authority to approve or disapprove a lessee's surface protection plans, and the mining supervisor is responsible to see that the plans are carried out. This, in effect, gives the mining supervisor the authority to see that air and water pollution and land erosion are prevented; other natural resources are protected; surface mined land rehabilitated according to the plan and maintained and protected until rehabilitation is complete; all surface openings and subsidence holes are filled in, closed, or barriers installed; all underground openings are permanently sealed; all surface structures are removed; and the plant site cleaned up, including rehabilitation of refuse piles, before termination of the lease.

Coal preparation plants, if covered by Federal coal leases, would be subject to the same regulations as mine plants covered by Federal leases.

Plugging surface openings that result from subsidence caused by underground coal mining does not assure that the site will remain safe, or suitable for other uses. Subsidence can continue over a period of many years. Unless the entire area is caved at the time of mining it is difficult to ascertain when the land will become stable.



An abandoned coal mining town at the old Dakota Star Mine near Stanton, North Dakota.

FEDERAL COAL LEASING

Authorities

Laws. The statutory authority for leasing all Federal coal deposits and Federal coal lands (other than acquired lands, including national resource lands and national forest lands), is contained in the Act of February 25, 1920, referred to as the "Mineral Leasing Act" (41 Stat. 437, as amended; 30 United States Code (U.S.C.) 181 *et seq.*). General mineral leasing provisions are found in Sections 181-194 of 30 U.S.C. Provisions dealing specifically with coal are codified under Sections 201-209 of 30 U.S.C.

Lands excluded from operation of the Mineral Lands Leasing Act include those acquired under the Appalachian Forest Act, and those in incorporated cities, towns, and villages and in national parks and monuments, those acquired under other Acts subsequent

to February 25, 1920, and lands within the naval petroleum and oil shale reserves (30 U.S.C: 181).

Lands disposed of with reservations of the coal deposits to the United States are subject to the provisions of the Mineral Leasing Act (30 U.S.C. 182).

Coal is subject to disposition by leasing only, (30 U.S.C. 181, 193), with the exception of permits to take coal for local domestic needs (30 U.S.C. 208).

The Secretary of the Interior is directed to reserve authority to cancel any prospecting permit upon failure of the permittee to exercise due diligence in the prosecution of the prospecting work in accordance with the terms and conditions of the permit (30 U.S.C. 183).

Total acreage in coal leases or permits held by persons, associations, or corporations may not exceed 46,080 acres per State (30 U.S.C. 184 (a) (1)), except that an application for 40 acres or multiples thereof, up to 5,120 additional acres in any one State, may be approved by the Secretary, if determined to be necessary to enable an applicant to carry on business economically and approval of the increased acreage is believed in the public interest (30 U.S.C. 184 (a) (2)). The Secretary may reserve to the United States the right to dispose of the surface not necessary to lessee's operations (30 U.S.C. 186). Lands or deposits may not be subleased without the permission of the Secretary. Each lease shall contain provisions for the purpose of insuring the exercise of reasonable diligence, skill, and care in the operation of said property (30 U.S.C. 187).

A lease may be cancelled in a proceeding in the United States District Court for noncompliance with the Act, the lease, or the regulations (30 U.S.C. 188).

The law gives the Secretary broad authority to make rules and regulations necessary to carry out the mineral leasing program under the Mineral Leasing Act of 1920 (30 U.S.C. 189). The Secretary is authorized to divide any of the coal lands or the deposits of coal owned by the United States, into leasing tracts of 40 acres each, or multiples thereof, in a form which in his opinion will permit the most economical mining of coal.

The coal lands or deposits may be offered for leasing upon application or Secretarial motion by competitive or other procedures as the Secretary may set forth in regulations (30 U.S.C. 201). When prospecting is necessary to determine existence or workability of coal deposits in unclaimed or undeveloped areas, applicants may be issued prospecting permits for 2-year terms, for not to exceed 5,120 acres. Prospecting permits may be extended for 2 years for good reason (30 U.S.C. 201). To more properly conserve resources of a coalfield or prospective coal area, lessees and permittees may enter into agreements for prospecting, development, or operation of such areas if it is determined by the Secretary to be in the public interest. Contracts operating under such agreements may be exempted from the maximum lease acreage limitations (30 U.S.C. 201-1).

Coal leases may be modified by including additional coal lands or deposits contiguous to the existing lease, to the extent that the total lease does not exceed 2,560 acres (30 U.S.C. 203). Upon showing that all workable coal deposits within a lease area will be exhausted within 3 years, the Secretary may, within his discretion, lease to such lessee additional tracts which, including the remaining deposit acreage, do not exceed 2,560 acres. The new lease would be issued under the same conditions as in the case of an original lease (30 U.S.C. 204).

Coal leases or deposits may be consolidated (30 U.S.C. 205). Noncontiguous coal lands may be leased (30 U.S.C. 206).

Lessees will pay the United States royalties on a minimum annual production, determined on an individual case basis prior to lease issuance. Such rates will be set out in the notice of competitive lease offer. Rental of the lands or deposits will be at least 25 cents per acre for the first year, 50 cents for the ensuing four years and $1 per acre thereafter. Leases are for indeterminate periods contingent upon diligent development. At the end of each 20-year period of the lease, the terms and conditions of the lease may be adjusted (30 U.S.C. 207).

In order to provide for the supply of strictly local domestic needs, the Secretary may issue limited licenses or permits to individual or municipalities free of charge (30 U.S.C. 208). The Secretary is authorized to waive or reduce rents or royalties to encourage the greatest ultimate recovery of coal (30 U.S.C. 209).

Surface rehabilitation is now in progress on old Northern Pacific Coal spoil piles at Colstrip, Montana.

The statutory authority for leasing coal on Federally acquired lands is contained in the Act of August 7, 1947, referred to as the "Mineral Leasing Act for Acquired Lands" (61 Stat. 913; 30 U.S.C. 351-359). Lands excepted from the Act include those acquired specifically for development of mineral deposits or within incorporated cities, towns, villages, or national parks or monuments. Lands available for leasing under the Mineral Leasing Act for Acquired Lands may be leased under the same as the provisions and conditions contained in the leasing program pursuant to the Mineral Leasing Act of 1920. There are, however, several exceptions. The Mineral Leasing Act for Acquired Lands requires the consent of the head of the Federal agency, department, etc., having administrative jurisdiction over the lands, before a deposit is leased. In addition, the agency head may subject the lessee to certain conditions to insure use of the land for the purposes for which it was acquired (30 U.S.C. 352). The agency which has such administrative jurisdiction may sell or convey the land, subject to existing mineral leases (30 U.S.C. 353).

The Secretary is also authorized to lease partial or future interests of the United States in acquired lands (30 U.S.C. 354). The Secretary may make rules and regulations necessary to carry out the provisions of the Mineral Leasing Act for Acquired Land (30 U.S.C. 359). However, the rules must be the same as those prescribed under the general Mineral Leasing Act of 1920 insofar as they are applicable.

The Secretary has delegated his authority to issue leases to the Director, Bureau of Land Management (BLM). The Director has redelegated his authority to the State Directors. Officials in BLM State Offices are authorized to issue coal leases.

The Secretary has delegated his authority to administer operations conducted under leases to the Director, Geological Survey.

Following is a list of statutes affecting the issuance of Federal coal prospecting permits and coal leases and operations thereunder, including environmental statutes:

- **30 U.S.C. 21a** – The Mining and Minerals Policy Act of 1970.
- **30 U.S.C. S71-77** – Coal Land Entries in General
- **30 U.S.C. S81-90** – Coal Land Entries Under Non-Mineral Land Laws with Reservation of Coal to United States

Mineral Leasing Act of February 25, 1920, 41 Stat. 437, **30 U.S.C.**
- **S181-184** – Leasing and prospecting permits
- **S186** – Reservation of easements or rights-of-way for working purposes; reservation of right to dispose of surface of lands; determination before offering of lease; easement periods
- **S187** – Assignment or subletting of leases; relinquishment of rights under leases; conditions in leases for protection of diverse interests in operation of mines, wells, and so forth; State laws not impaired
- **S188** – Forfeiture, cancellation or reinstatement of leases
- **S188a** – Surrender of leases
- **S193** – Disposition of deposits of coal, and so forth
- **S193a** – Preference right of United States to purchase coal for Army and Navy; price for coal; civil actions; jurisdictions
- **S201-209** – Coal

Mineral Leasing Act for Acquired Lands, 61 Stat. 913, **30 U.S.C. S351-359** (1947) (**S358** not applicable to coal)
- *Chapter 12A.* – Entry and Location on Coal Lands on Discovery of Source Material **S541-541i**
- *Chapter 13* – Control of Coal-mined Fires **S551-558**
- *Chapter 14* – Anthracite Mine Drainage and Fire Control **S571-576**
- *Chapter 18* – Coal Research and Development **S661-668**
- *Chapter 22* – Coal Mine Health and Safety **S801-960**

River and Harbor Act of 1899, 30 Stat. 1152; **33 U.S.C. S407**

National Environmental Policy Act of 1969, 83 Stat. 852; **42 U.S.C. S4321** *et seq.*

Federal Water Pollution Control Act, 62 Stat. 1155; **33 U.S.C. S1151**

Water Quality Improvement Act of 1970, 84 Stat. 91; **33 U.S.C. S1151** *et seq.*

Clean Air Act of 1970; **42 U.S.C. S1857** *et seq.*, as amended by P.L. 91-604 (12-20-70) **84 Stat. 1676** and P.L. 93-319.

Regulations. Regulations governing the prospecting for and leasing or contracting for coal are found in Title 43, Code of Federal Regulations (CFR) 23, 43, CFR 3500, and 30 CFR 211.

Title 43, CFR 3500 primarily restates provisions of the "Mineral Leasing Act" and the "Mineral Leasing Act for Acquired Lands" which are summarized above. These regulations set out the administrative requirements for issuing prospecting permits and leases.

Part 23 applies only to those lease permits issued after January 18, 1969. Part 23 requires that a plan be approved before any surface disturbance in conjunction with prospecting or mining is initiated. The regulations set forth the requirements for technical examinations of proposed operation sites and approval of prospecting or mining plans. Performance bonds or other guarantee of satisfactory execution of terms of a permit, lease, or contract are required.

Title 30, CFR 211 deals with requirements for supervision of coal prospecting and mining operations by Geological Survey. This part concentrates on insuring the orderly development of the publicly owned coal lands, accounting of coal produced, and rent and royalty payments. These regulations are nov

in the final stages of revision, and in addition to the above they cover surface protection requirements to the other resources and reclamation.

Following is a list of regulations of the Department of the Interior concerning Federal coal leasing, from Titles 30 and 43 of the CFR'

43 CFR 23: Surface exploration, mining and reclamation of lands.

43 CFR 3000 (Group 3000); Mineral Management
- *Part 3000* – Mineral Management; General

43 CFR 3500: Leasing of Minerals Other than Oil and Gas
- *Subpart 3510* – Prospecting permits
- *Subpart 3520* – Preference-right and competitive leases
- *Subpart 3530* – License to mine coal
- *Subpart 3550* – Fractional and future interest leases and permits
- *Part 3560* – Special Leasing Acts
- *Subpart 3565* – National Forest Lands in Minnesota
- *Subpart 3566* – Lake Mead Recreation Area
- *Subpart 3567* – National forest Wilderness

30 CFR Subchapter C: – Explosives and Related Articles; Tests for Permissibility and Suitability
- *Part 15* – Explosives and Related Articles
- *Part 16* – Stemming Devices
- *Part 17* – Blasting Devices

30 CFR Subchapter D: Electrical Equipment, Lamps, Methane Detectors; Tests for Permissibility; Fees
- *Part 18* – Electrical Motor-Driven Mine Equipment and Accessories
- *Part 19* – Electric Cap Lamp

30 CFR Subchapter L: Interpretations
- *Part 45* – Interpretations; Title II, Federal Code Mine Safety Act of 1952

30 CFR Subchapter O: Coal Mine Health and Safety
- *Part 70* – Mandatory Health Standards – Underground Coal Mines
- *Part 74* – Coal Mine Dust Personal Sampler Units
- *Part 75* – Mandatory Safety Standards – Underground Coal Mines
- *Part 77* – Mandatory Safety Standards, Surface Coal Mines and Surface Work Areas of Underground Coal Mines
- *Part 80* – Notification, Investigation, Reports and Records of Accidents
- *Part 81* – Procedure for identification of Representatives of Miners at Mines.
- *Part 90* – Procedure for Transfer of Miners with Evidence of Pneumoconiosis
- *Part 100* – Civil Penalties for Violation of the Federal Coal Mine Health and Safety Act of 1969

30 CFR Chapter II: Geological Survey
- *Part 200* – (a) Forms and Reports – Coal
- *Part 211* – Coal-mining Operating and Safety Regulations
- *Part 216* – Operating and Safety Regulations

30 CFR Chapter III: Board of Mine Operation Appeals
- *Part 301* – Procedures Under Federal Coal Mine Health and Safety Act of 1969

30 CFR Part V: Interim Compliance Panel (Coal Mine Health and Safety)

30 CFR Subchapter A: Coal Mine Health
- *Part 501* – Permits for Noncompliance

30 CFR Subchapter B: Coal Mine Safety
- *Part 503* – Permits for Noncompliance With the Electric Face Equipment Standard

30 CFR Subchapter C: General Administration
- *Part 505* – Practice and Procedure for Hearings

Administration

Roles of Federal Agencies. The roles of Federal agencies, such as the BLM, Geological Survey, Bureau of Mines (BM), Mining Enforcement and Safety Administration (MESA), U.S. Fish and Wildlife Service, and the Bureau of Reclamation in the United States Department of the Interior, the Forest Service of the U.S. Department of Agriculture, and the Corps of Engineers of the Department of the Army, in coal lease administration have been modified by passage of the National Environmental Policy Act (NEPA), in 1969. Before the passage of NEPA, the land management agencies were guided by specific legislation pertaining to the management of lands under their jurisdiction. NEPA, while it did not change the basic concepts of the enabling and directional acts, did broaden the management philosophy of these agencies and created a more definitive approach to their management and administration with respect to environmental protection.

Statutory limitations are found in several laws which constrain management of the coal resource. These constraints affect not only the leasing of coal, but also operating methods and rehabilitation practices. These laws include the National Wilderness Preservation Act, various national recreation area acts, the Wild and Scenic Rivers Act, and others that pertain to national recreation and heritage programs.

Bureau of Land Management. The BLM classifies and manages national resource lands and their related resources according to principles of multiple use, sustained yields, and environmental quality.

Management of mineral and mineral material resources, which are extractive operations impacting at some point in time on the steady-state management of renewable resources, includes the need to furnish surface managers with estimates of probability of mineral discovery and timing of extraction, as well as projecting the potential nature and magnitude of impact from such events when and if they occur.

Resources managed by the BLM include timber, minerals, and land,

wildlife habitat, livestock forage, water, public recreation values, and open space. Bureau programs provide for the protection and orderly use of these resources.

The Bureau administers laws relating to mineral resources of all Federal lands, including lands under its primary jurisdiction, submerged lands of the Outer Continental Shelf, lands withdrawn by other Federal Agencies, acquired lands, and Federal mineral reserves in private lands.

In the Federal coal leasing program, the BLM exercises the Secretary of the Interior's discretionary authority under the mineral leasing acts to determine whether or not leases, permits, or licenses are to be issued. It is responsible for issuing leases, permits and licenses, and for formulating the surface, non-mineral resource, and rehabilitation requirements to be incorporated in them. With respect to Federal coal deposits where BLM has surface management responsibilities BLM determines the adequacy of environmental protection and rehabilitation aspects of all mining operation plans. The Geological Survey in conjunction with BLM conducts compliance examinations on leased areas, as well as on prospecting permit or licensed lands beyond operating areas and consults with BLM on matters concerning surface disturbance, reclamation, and other land use considerations prior to approval of mining or development plans for leased areas.

In addition to managing the national resource lands, administering mining laws applicable to all Federal lands, and conducting official cadastral surveys of all Federal lands, the BLM also maintains the official land status records for all Federal lands. Such recored are maintained for areas within their jurisdictions by BLM State Offices in Anchorage, Alaska; Phoenix, Ariz.; Sacramento, Calif.; Denver, Colo.; Boise, Idaho; Billings, Mont.; Reno, Nev.; Santa Fe, N. Mex.; Portland, Oreg.; Salt Lake City, Utah; Cheyenne, Wyo.; and in the Eastern States Office in Silver Spring, Md.

Land records show to whom patents were issued when title to lands in the public domain passed to non-Federal ownership, but records of subsequent transfers are not maintained, unless the lands are again acquired by the Federal Government by purchase or exchange.

Records of the status of Federal lands show which agency has primary jurisdiction; Federal agency withdrawals, reservations, classifications, and other constraints on management of the land by the agency with primary jurisdiction; outstanding mineral leases (and mining claims in some instances), prospecting permits, right-of-way permits, and some other types of contractual obligations; pending applications that give the applicant a preference right; reservations to the Federal Government of minerals, right-of-way, etc. in patented lands; reversion clauses if prescribed uses of patented land change; and other information relating to status of the land or restrictions on its use.

Under procedures in effect prior to the Secretary's suspension of coal leasing, applications to lease coal were filed in BLM State Offices and assigned serial case numbers, in a manner similar to that followed for other types of land and mineral applications. Coal lease case files are maintained in the State Offices until the leases are terminated, after which the files are sent to Federal records centers for storage. Such files can be retrieved promptly when needed.

Coal leases are authorized or terminated by appropriate officials in BLM State Offices. The Federal agency with primary jurisdiction over the surface resources of land underlain by coal is responsible for recommending coal lease provisions concerning surface resources. Coal extraction is supervised by the Geological Survey.

Geological Survey. The Geological Survey is the principal Federal Agency concerned with preparing maps of the physical features of the country, conducting studies of mineral resources and providing earth science information essential to the use and conservation of the Nation's land, mineral, and water resources.

The Conservation Division of the Geological Survey is responsible for classifying Federal lands as to coal occurrence and values, as required by law in land disposal or exchange. It provides mineral information needed for multiple-use land planning, and provides assistance in making geologic, engineering, and economic value determinations needed for Federal coal leasing. The GS is responsible for supervision of coal mining operations on Federal lands and Federal held mineral reserve on private land. Supervision of the mining operation is under the terms of leases issued by the BLM. The area mining supervisor of the Conservation Division approves operations plans that meet requirements of the mineral leasing acts, regulations, lease terms and conditions, and environmental and rehabilitation stipulations. The division makes compliance examinations of operations on Federal coal leases and maintains records of operations of lessees, permittees, and licensees.

Drilling, sampling and geologic mapping is accomplished in conjunction with classification actions and for general support of BLM leasing programs. Data and information gained is available for land-use planning and for resolution of mineral vs. surface conflicts. Geologists and engineers are presently gathering additional data for determining Known Coal Leasing Areas, where further coal prospecting is not needed prior to consideration of the lands for coal leasing. Designation of these areas is a key data base for EMARS tract selection procedures.

Mining Enforcement and Safety Administration. MESA, an agency of the Department of the Interior, is responsible for administering the Federal Coal Mine Health and Safety Act. Coal mine health and safety, assessment and compliance, and education and training are functions of this office. MESA has jurisdiction over all coal mines and mine plants whether or not the operation is pursuant to a Federal coal lease.

Bureau of Mines. The BM conducts research necessary to the governmental function of assisting the private sector to produce an appropriate and substantial share of the national mineral and fuel needs in a manner that best protects the public interest.

Specifically, concern is directed toward the satisfaction of current and emerging mineral needs; the real cost of such achievements; the assessment of related social and economic factors; minimization of occupational hazards to workers, reduction of wastes; and assurance that mineral raw materials are supplied and mineral-based products are used with minimal social and environmental cost. To accomplish these objectives, the Bureau performs research, provides information to the public, and conducts inquiries pertinent to the extraction and processing of mineral fuels. BM programs are designed to enhance public benefits from coal mining on both Federal land and private land.

Forest Service. The Forest Service manages approximately 186 million acres of national forests and national grasslands. All lands in Forest Service jurisdiction are managed in accordance with the principles of multiple use and sustained yields, as expressed in the Multiple Use Act of June 12, 1960.

Historically, lands managed by the Forest Service have been subject to mineral exploration and mining. Coal leasing is subject to the constraints and direction developed in multiple use planning.

Federal Coal-Leasing Procedures. Authorities for managing the Federal coal resources, reviewed in the preceding section, provide for the disposition of coal by lease, except that limited licenses may be issued to supply coal free of charge to individuals or municipalities for strictly local domestic needs. Because of their insignificance, free use licenses are not treated further in this statement.

The procedures and requirements relating to the Federal coal prospecting permits, preference right leases, and competitive leases are summarized below, in accordance with the normal sequence of events.

Principals in the actions are the applicant, permittee, or lessee; the leasing agency (BLM); the land-managing agency; and the operations-managing agency (Geological Survey). The land-managing agency is the Federal agency with primary jurisdiction for the land in which Federal coal occurs, such as the BLM, Forest Service, Fish and Wildlife Service, Corps of Engineers, Bureau of Reclamation, Tennessee Valley Authority, Department of Defense, or others.

Geological Survey, as the operations-managing agency, ensures that the permittee or lessee complies with the terms of the prospecting permit or coal lease. Operations management includes inspections to ensure compliance with approved prospecting and mining plans, review of reports that permittees and lessees are required to submit periodically, maintenance of accounts of coal mined and rents and royalties paid, issuance of compliance orders, and recommendations to the BLM for permit and lease cancellation for noncompliance or termination for other reasons.

Initiation of Action. (a) Independently, or on the recommendation of Geological Survey, the BLM may nominate coal in a specified location for competitive leasing. Such recommendations will be brought into a common rationale as to timing, size and place of leasing under EMARS.

(b) Under the suspended procedures, an applicant could file an application at a BLM State Office for a preference right lease when commercial quantities of coal have been discovered on a previously issued prospecting permit, or for a competitive lease. BLM then recorded the application, assigned a case number, collected applicable filing fees and rents, verified the applicant's qualifications, determined the status of the land involved, and determined if a coal lease would be appropriate. Nonqualifying applications were rejected. Applications for coal prospecting permits are now rejected in accordance with D.O. 2952. When it becomes appropriate for this order to be rescinded, prospecting permit applications may then be considered under suitable EMARS guidelines.

Evaluation Report. Geological Survey reports to the BLM the nature and extent of coal deposits in the lands, recommends mineral protection stipulations and bond requirements, and minimum production or exploration requirements.

If an application was received by BLM under suspended procedures for a prospecting permit, and Geological Survey reported that the land is known to contain workable coal, BLM rejected the application.

If the application was for a coal lease, Geological Survey established rentals and royalties, for both preference right leases and competitive leases. For competitive leases, Geological Survey established the minimum acceptable bonus bid. With respect to preference right lease applications, Geological Survey verifies the applicant's discovery of coal in commercial quantities or recommends rejection of the application if coal was not discovered. BLM rejects a preference right application if Geological Survey reports that there was no discovery of coal of commercial value.

Environmental Analysis and Technical Examination. Under current interim procedures, the BLM (by Instruction Memorandum 73-354 of August 21, 1973), the Geological Survey (by Instructions of November 24, 1972, and May 3, 1973), and other surface management agencies required their appropriate officials to make an environmental analysis before:

(a) Issuance or modifications of a coal prospecting permit or coal lease (Suspended until implementation of EMARS, except for consideration of short-term criteria).

(b) Adjustment of terms for the continuance of a lease beyond a 20-year period or the continuance of a prospecting permit beyond a 2-year period.

(c) Approval of a prospecting or mining plan, under existing leases or permits.

The involved agencies (Geological Survey, BLM, and other surface-managing agency, if any), make the environmental analysis and technical examination as a team, using an interdisciplinary approach. The team's report includes (1) the present condition of the environment and what effects alternative mining

methods may have on the environment, (2) whether or not the lease or permit should be granted, based on environmental considerations, (3) management principles to be inserted into lease or permit stipulations, and (4) the need to prepare an environmental statement. An environmental statement describes the proposed action, the environment, impacts of the environment, alternatives to the proposed action, mitigating measures, unavoidable impacts, relationships between benefits of the action and long-term productivity of the area, and irretrievable resource commitments.

Permit or Lease Preparation. If the BLM finds that issuance of a prospecting permit or coal lease is appropriate, the EMARS record is reviewed by the land managing agency and operations-managing agency. Appropriate revisions are incorporated in the final document by BLM.

Administering Currently Active Coal-Prospecting Permits.

(a) Permittee pays rentals to BLM during the life of the permit.

(b) The Geological Survey informs permittee of regulations, reporting procedures, and other requirements.

(c) Permittee submits prospecting plan to the Geological Survey, the operations-managing agency. Requirements for such a plan are specified in 43 CFR 23, 30 CFR 211, and in Geological Survey guidelines of May 19, 1972. A prospecting plan includes narratives and maps describing proposed actions, including road locations, drill site locations, equipment to be used, and rehabilitation measures.

(d) The Geological Survey reviews the plan and consults with the BLM and any other land-managing agencies after any modifications that are determined to be appropriate are made. The Geological Survey then submits the plan to the permittee to make the necessary changes, if any, to ensure environmental protection and proper operation methods. If revision of the plan is necessary, the final version is again reviewed by BLM and other concerned land-managing agencies after which the plan is approved by the Geological Survey. All agencies involved base their concurrence with the plan on their environmental analysis, and if appropriate, environmental statements, prepared with public envolvement by interdisciplinary teams.

(e) Only after the prospecting plan has been approved can the permittee begin prospecting operations. He is required to prospect in accordance with the plan, complete required rehabilitation measures, and submit records of drilling or other exploration to the Geological Survey. During exploration, the Geological Survey makes compliance examinations of the prospecting operations, and the land-managing agency makes compliance examinations outside of the area of operations. These might include access rights, surface protection, and rehabilitation. Any deficiencies are reported to the Geological Survey, to secure compliance from the permittees. The Geological Survey maintains records of all operating activities, receives report of the land management agency when lands have been satisfactorily rehabilitated, and recommends final action on the permit by BLM, the leasing agency.

(f) A permittee may request BLM to grant a 2-year extension of a prospecting permit, if prospecting was not completed during the initial permit period. BLM requests a report form the Geological Survey on the need for an extension. The Geological Survey can recommend an extension if the permittee diligently prospected during the first term but needs additional time to determine the nature of the coal. If appropriate, BLM can grant an extension.

Administering Currently Active Federal Coal Leases.

(a) Preference right or competitive coal leases which have been issued, following the procedures described above, require the lessee to pay annual rentals and advance royalties to BLM, the leasing agency. BLM collects rentals for 5 years or until production starts.

(b) The Geological Survey, the operations-managing agency, informs lessee of regulations, required reports, and other procedures and collects rentals or advance royalties after the first 5 years or after production starts, whichever is sooner.

(c) Lessee submits plan of operation to the Geological Survey. The appropriate Federal agency prepares an Environmental Impact Statement, if required. In case the lease is for Federal coal underlying non-Federal land, the lessee must consult with the surface land-owner and arrange for reimbursement of compensable losses such as loss of productivity and damage to surface improvements.

(d) The Geological Survey refers the operating plan to the land-managing agency for assessment of adequacy with respect to protection and management of related resources, based on environmental analysis and environmental impact statements where appropriate. New mining plans are available for public comment for 30 days. After such modifications as the Geological Survey may require the lessee to make, a final review by the leasing agency and land-managing agency is requested by the Geological Survey. If all is in order, the operating plan, which then becomes part of the base conditions, is approved by the Geological Survey.

(e) The lessee commences operations authorized by lease, including development, production, and rehabilitation and submits drilling data, mining progress reports, rehabilitation progress reports, and progress maps to the Geological Survey.

(f) The Geological Survey makes compliance inspections of mining operations and land-managing agencies make compliance examinations outside of the area of operations. These might include access rights, surface protection, rehabilitation, and coordination of operations with other resource uses. Any deficiencies are reported to the Geological Survey to secure compliance from the lessee. The Geological Survey maintains records of all operations and consults with the Bureau of Mines and MESA about mining methods, health and safety, and mine or outcrop fires.

(g) The lessee pays royalties on coal mined to the Geological Survey. Production reports are submitted quarterly. The lessee reports the number of tons of coal mined, the

royalties due, coal inventories, and the selling price of the coal produced. An annual independent audit of production records is required. In addition, reports for all leases after 1969 must include (1) an annual report describing operations, area of land affected, area of land disturbed, amount of land rehabilitated, and method of rehabilitation, (2) grading and backfilling progress, (3) progress or planting, and (4) 30 days notice before completion of mining and rehabilitation.

(h) The Geological Survey maintains accounts of coal produced and receipts, supplying them periodically to BLM, and verifies production records submitted by lessee.

(i) Leases may on occasion be relinquished, cancelled by BLM for noncompliance or nonpayment, or allowed to expire. Modifications are possible and are subject to requirements similar to those that pertain to leasing. Assignments require the advance approval of the Geological Survey and BLM.

(j) Leases are continued under adjusted terms beyond the initial 20-year period. BLM requests reports from the land-managing agency and the operations-managing agency about the appropriateness of continuance and requirements that should apply to a lease continuance. Agencies involved cooperate in making a technical examination, an environmental analysis, and in preparing an environmental statement if appropriate. On the basis of environmental and technical studies, stipulations and bonding requirements are developed . reviewed, and recommended to BLM for incorporation in the lease, along with recommendations by the Geological Survey as to rents, royalties, and production requirements. BLM incorporates updated terms and conditions in the adjusted lease. The lessee can seek administrative or legal relief from requirements of revisions.

(k) When a lessee applies for relinquishment, BLM requests a report from the Geological Survey on the status of accounts, works, and lands and requests a surface condition report from the land-managing agency. The Geological Survey requires the lessee to correct any deficiencies in rehabilitation of the area, in making payments and initiates collection on performance bond if necessary. Unpaid accounts are turned over to BLM for collection.

When all requirements are met, BLM terminates the coal lease and releases the performance bond.

Enforcement of Federal Requirements and Influence of State Requirements.

Enforcement of Federal Requirements. On January 18, 1969, 43 CFR Part 23, revised regulations for surface exploration, mining, and rehabilitation of lands became effective.

The National Environmental Policy Act of 1969 required analysis of proposed Federal actions to determine their impact on the quality of the environment.

As of September 12, 1974, there were 530 active Federal coal leases. Of these, 515 leases were in Colorado, Montana, New Mexico, North Dakota, Utah, Wyoming, and Oklahoma. In addition, in the six major western coal producing states mentioned above, excluding Oklahoma, there were 233,559 acres under preference right lease application and 176,735 acres under active prospecting permit. All the prospecting permits were issued before the Director, BLM, suspended field approval of permits on January 23, 1971. The holders of permits which were issued can be expected to apply for preference right leases if exploration discloses commercial quantities of coal. The responsibility for administering the existing leases and permits and processing the pending applications is large. Many of the previously issued leases will become operational by 1980, others in the following decade.

The 110 prospecting permits require periodic compliance inspections. Many holders of previously issued leases not now in production will be submitting mining plans for review. Each of these reviews will require team effort among the BLM, Geological Survey, and other surface-managing agencies. Environmental analyses will precede approval of mining plans.

Examples of standard prospecting permit and coal lease requirements and special stipulations are included in Section IV.

The Geological Survey has established inspection or examination standards to assure compliance with regulations, laws, stipulations, and lease contracts. USGS requires that active prospecting permits must be examined by USGS twice a year, inactive prospecting permits once a year, active leases three times a year, and inactive leases once a year.

Secretarial Order No. 2948 of October 6, 1972 was issued to clarify the "Division of Responsibility Between the Bureau of Land Management and the Geological survey for Administration of the Mineral Leasing Laws – Onshore."

In brief, the BLM issues and terminates coal-prospecting permits and coal leases, but during the life of permits and leases the Geological Survey supervises mining operations. The two agencies cooperate in determining the propriety of issuing permits and leases and the nature of requirements to be incorporated in them. Also, "BLM is responsible for compliance examinations of environmental protection requirements outside the operating area and for reporting infractions to GS" so that compliance might be attained. It was assumed that such BLM compliance inspections were to be conducted on national resource lands covered by BLM permits or leases. The order is silent as to the responsibility of other Federal resource management agencies when BLM coal prospecting permits or coal leases cover applications (supervised by the Geological Survey) on Federal lands other than national resource lands (managed by BLM), such as national forests under the jurisdiction of the Forest Service or National wildlife refuges under the jurisdiction of the Fish and Wildlife Service. These other agencies conduct compliance examinations and report to Geological Survey with respect to fulfillment of environmental protection requirements.

Resource management agencies are governed by laws, regulations, and procedural policies applicable to them

in managing the lands and resources for which they have administrative jurisdiction. To fulfill those responsibilities, they must by some means ensure that coal-mining practices are in accord with other resource management objectives. Usually this is achieved through the cooperation of personnel representing all of the Federal agencies that are involved. Interdisciplinary teams representing the BLM as the leasing agency, the Geological Survey as the operations managing agency, and others representing the land-managing agency (BLM, Forest Service, Fish and Wildlife Service, Bureau of Reclamation, Department of Defense, or others) cooperatively conduct technical and environmental examinations before and during mining operations.

Influence of State Laws in Enforcing Designing and Both Mining and Reclamation Requirements. All states with major coal deposits have recently enacted or amended laws that require specific plans to be made before a permit to operate a coal mine will be issued. These state laws control disturbances to the environment and require that disturbed lands rehabilitated. To obtain State mining permits when required, companies must generally submit detailed mining and reclamation plans to a State board or commission for review. Some States hold public hearings where the mining plan is reviewed and public comments received.

State Permits cost $50 or more per acre per year, based on the number of acres disturbed annually. The company is also required to post a bond based on the number of acres to be mined or on the cost of rehabilitation. The bond amount may be reduced as lands are satisfactorily rehabilitated. The bond amount varies considerably between States with amounts ranging from $100 per acre or $1,000 per operation to $3,000 per acre.

Inspections for compliance are made by the staff of the State mine inspector or may be the responsibility of some other State agency.

Magnitude of Federal Coal-Leasing Program

Present Coal Leases. As of March 1, 1973, there were 530 Federal coal leases covering 779,367 acres under the administrative jurisdiction of the BLM in 14 States. About half (55%) of the surface is owned by the Federal Government, and the remaining (45%) surface is privately owned, as shown on Table 1-15, compiled from records of the BLM.

Alaska. In Alaska there were four Federal coal leases in 1973, three in the Nenana field of central Alaska near Healy; and one at Homer, at the south end of the Kenai coal field, 200 mi southwest of Anchorage. There are two preference right lease applications in the Bering River field, 180 mi east of Seward; two in the Arctic Slope field and one in the Jarvis Creek field. Only the leases in the Nenana field are producing. The coal production is by strip mining.

The coal from the Nenana field, served by the Alaskan Railroad, is used for powerplant purposes and for domestic and space heating in the Fairbanks, Alaska area. The Bering River Coalfield is being developed for foreign export. The Matanuska field northeast of Anchorage has produced coal for local use from private lands.

Alaska has extensive coal areas, but most have not been studied in detail. The North Slope field is the largest, extending from north of the Brooks Mountain Range to the Arctic Ocean. It has about 92 percent of the states estimated strippable reserves. The Nenana and Matanuska fields are servedsby rail. Water transportation is available to the Kenai and Bering River fields. Most of the others are inaccessible or accessible only by river during the ice-free summer months.

Under the act of July 7, 1958, Alaska was granted the right to select 102,550,000 acres of land. Also by Public Land Order 4582 of January 17, 1969, all unreserved Federal lands have been withdrawn, 267,657,000 acres, to accommodate Alaskan Native claims. Both the State of Alaska and Alaskan Natives are selecting mineral lands, including coal. Consequently, until the State selections and Native claims have been satisfied, Federal leasing will be limited.

California. The small, isolated deposits of coal in California are located in the northern part of the state. The Federal Government has

Table 1-15
Federal Coal Leases

Coal Provinces and States	Number of Leases	Surface Ownership: Federal Acres	Surface Ownership: Private Acres	Total Area Leased Acres	Surface Ownership: Federal Percent	Surface Ownership: Private Percent
Pacific Coast						
Alaska	4	1,520	1,073	2,593	59	41
California	1	80	0	80	100	0
Oregon	3	5,403	0	5,403	100	0
Washington	2	0	521	521	0	100
Sub-total	10	7,003	1,594	8,597	81	19
Rocky Mountain and Northern Great Plains						
Colorado	112	67,472	54,606	122,078	55	45
Montana	17	1,265	34,967	36,232	3	97
New Mexico	28	14,760	26,198	40,958	36	64
North Dakota	20	0	16,436	16,436	0	100
Utah	195	253,374	13,335	266,709	95	5
Wyoming	91	82,737	117,196	199,933	41	59
Subtotal	463	419,608	262,738	682,346	61	39
Eastern and Interior States						
Alabama	1	0	200	200	0	100
Kentucky	1	1,282	0	1,282	100	0
Ohio	1	144	0	144	100	0
Oklahoma	53	1,321	85,477	86,798	2	98
Subtotal	56	2,747	85,677	88,424	3	97
Grand Total	530	429,258	350,009	779,367	55	45

only scattered parcels. There is one lease of 80 acres in Mendocino County. There has been no production from this lease nor in the state since 1970.

The estimated recoverable coal reserve is 25,000,000 tons. The coal is subbituminous with a sulfur content of 2 to 3 percent.

Because of the small deposits, no development is anticipated except for minor local use.

Oregon. There is one Federal coal lease in Clackamas County and three in Coos County, Oregon, in 1973. The leases were not producing in 1973, and under 500 tons were produced in 1971 for local use.

The coal seams average 4 ft in thickness. They are relatively impure and are considered to have low to medium sulfur content. No immediate development is anticipated.

Washington. Two leases totalling 520 acres in Washington are located in Lewis County in the western part of the state, north of Centralia. This area has a strippable reserve being used for electric power generation. Nearly all of the coal land is non-Federal.

While development of coal in Washington is increasing, Federal acreage is very minor and will be considered only where adjacent to private coal that is being developed.

Colorado. The 112 Federal coal leases in Colorado are located in thirteen counties. There are 12 producing mines as shown in Table 1-16.

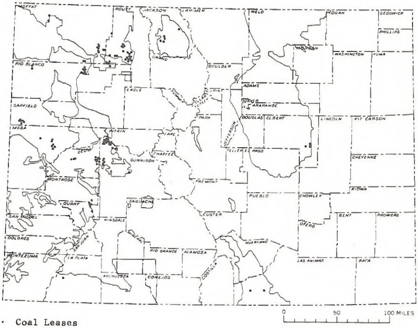
Colorado has 29,600 square miles of land underlain by coal, with eight coal regions. While 32 counties are underlain by coal-bearing formations, only 14 have Federal coal leases. (See Figure 1-23.)

The eight Colorado coal regions are:

1. Green River
2. Uinta
3. San Juan River
4. North Park
5. South Park
6. Canon City
7. Denver Basin
8. Raton Mesa

The first five are in the Rocky Mountain Coal Province whereas the other three are in the Northern Great Plains Coal Province. The Green River, Uinta, and San Juan River areas are major producers.

The North Park area in Jackson County is at an elevation of 8,000 ft



· Coal Leases

Occurrence of Coal in Colorado

Figure 1-23. Colorado coal leases.

Table 1-16
Federal Coal Leases in Colorado

County	No. Leases	No. Producing Mines (Strip)	(Underground)	Uses
Delta	11		1	4
Elkert	4			
Garfield	6			
Gunnison	31		5	1,2,3,4
Jackson	5			
La Plata	1		1	1
Los Animas	2		1	1
Mesa	14			
Moffitt	13		1	1,2,3
Montrose	5			
Ouray	4			
Petsur	7		1	
Rio Blanco	11		1	
Routt	18	2	1	1
Totals	132[1]	2[2]	12[2]	

[1]Where lease is in two or more counties, it is shown in each county.
[2]Mines operating in more than one county are shown in each county.

Uses: 1. Powerplants
2. Blending (Core)
3. Local
4. Coking Coal

and above. There has been no recent mining. However, the thick coal seams with available water makes the area attractive for a powerplant location.

Middle Park area in Grand County has no known mineable seams, nor are there any Federal leases. South Park in Park County is at 9,000 ft elevation and has had no production.

The Denver Basin located in the north central part of the state includes 4,900,000 acres. Federal coal lands are less than 9 percent or 427,800 acres. Much of this basin underlies extensive surface improvements including the Denver Metropolitan area. The coal is 1,000 ft or less below the surface. There are four Federal leases for 2,680 acres on the eastern edge of the basin in Elbert County. This area could be surface mined, but there is no apparent immediate plan to do so.

The Raton Mesa area located in Huerfano and Los Animas Counties, in the south central part of Colorado, has two Federal leases in Los Animas County. There was no Federal production in 1972. All of the south portion of the Raton Basin is in the Maxwell Land Grant. Of the 559,100 acres underlain by coal-bearing formation, Federal ownership is about 32 percent or 181,000 acres. All 1972 production was from private holdings.

The coal is deep mined and is used for coking at the Colorado Fuel and Iron Company's steel plants at Pueblo, Colorado. The captive CF & I Allen Mine adjoins a Federal lease, and some production will come from the lease by 1980.

The Canon City field includes no Federal coal ownership. This field has coal similar to Raton Mesa. The coal is used for powerplant fuel and industrial purposes.

The major producing field is the Green River region located in the northwestern part of the state. All Federal production is located in the southeastern portion of the field in Moffat and Routt Counties. Coal is mined by both surface and underground methods. Federal ownership of the coal-bearing formation is about 82 percent of 1,872,000 acres.

There are two underground and two strip mines operating on Federal leases. Several other operating mines are on private land. The coal is used for power plants, industrial, coking and local needs.

Of the 31 leases in the two counties, four are producing, eight adjoin the producing areas and are part of the mining units of the operations.

The Green River region has the greatest amount of strippable coal in the state. Water may be available from the Yampa River. Together these factors could support three synthetic fuel plants. Increases have been made in powerplants and further increases have been considered. These coals contain an abundance of bituminous coal in Routt and Moffat Counties with only limited occurrences of anthracite. It is of good quality with low ash and sulfur and averages 12,000 BTUs per pound.

The Uinta region lies south of the Green River area in the west central part of the state. It covers portions of Moffat, Rio Blanco, Garfield, Mesa, Montrose, Delta, Gunnison, and Pitkin Counties.

Within the Uinta region there are a number of coalfields that have produced considerable coal in the past. Present Federal leases, however, are mainly in five locations: Book Cliffs, Carbondale, Crested Butte, Somerset, and Grand Mesa. Much of the coal has coking characteristics and is shipped to steel mills. All is mined underground.

Reserves in the area are large, and water may be available. Accordingly, three synthetic fuel plants could be supported, one near Meeker on the White River, the second on the Colorado River above Grand Junction, and the last on the Gunnison River near Delta. Underground mining costs being high, is more likely that any increased production will result from the greater need for metallurgical grade coal rather than for conversion to gas or oils.

The San Juan River region is in the southwestern portion of the state. The region covers all or parts of Montrose, San Miguel, Delores, Montezuma,

Tipple and conveyor at Pittsburg and Midway Coal Mining Company's Edna strip mining in Routt County, Colorado.

LaPlata, and Archuleta Counties. Although there are several producing mines in LaPlata County, only one is on a Federal lease. This small operation is on 120 acres of Federal mineral estate with private surface ownership. The mine supplies a few thousands tons per year to local residents. There are no Federal leases in the other counties within the San Juan River region.

Peabody Coal Company operates a small strip mine on private land, supplying coal to a small coal-fired powerplant near Nucla, Colorado in Montrose County. Other small mines in LaPlata County are on private land and supply local needs including a small powerplant at Durango. The area is quite rugged and access is poor. There are no railroads. Although most operations are underground, there are some areas of thick coal that may be suitable for strip mining. The available coal could support a large powerplant in the Durango area and one near Nucla or Naturita. The possible water source would be the Animas River for Durango and San Miguel River for the Nucla proposal. Another location is in the eastern part of Montrose County. Kemmer Coal Company has four Federal leases and other coal lands that would supply the fuel. Water supplies are inadequate for all the synthetic fuel or powerplants proposed for Colorado. Some of the future developments will require processes that use very little water, or growth will stop when the water supply is fully committed.

New Mexico. The two major areas in New Mexico are the Raton Basin in the Northern Great Plains Coal Province and the San Juan Basin in the Rocky Mountain Coal Province. See Figure 1-24.

In the Raton Basin located in the northeastern part of New Mexico, the Federal Government has mineral rights to only a few isolated tracts and no surface ownership. Nearly all of the coal-bearing formations are within the privately owned Maxwell Land Grant. The three leases totalling 200 acres are underground operations. Only one lease is operating and producing a small amount of coal for local use. The underground York mine operated by Kaiser Steel Corporation is entirely on private lands.

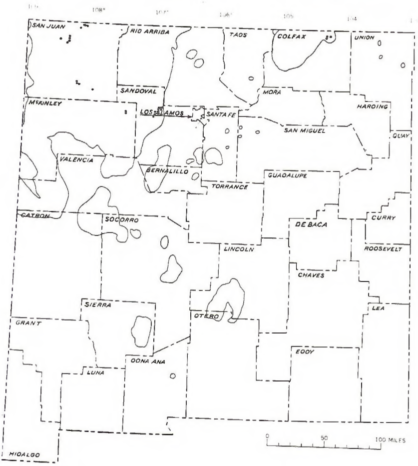
The San Juan Basin is located in the northwestern part of the state. It covers all or parts of five counties, including the eastern portion of the Navajo Indian Reservation.

All of the leases are located near the coal outcrops of basins.

There are several other small coal areas in the state. Several have

Table 1-17
Federal Coal Leases in New Mexico

County	No. Leases	Total Acreage	No. Prod. Mines	Use
San Juan Basin				
McKinley County	5	14,491.16	1	Powerplant
Rio Arriba County	1	80.00	0	
Sandoval County	9	9,742.59	0	
San Juan County	10	16,442.00	1	Powerplant
Raton Basin				
Colfax	3	200.00	1	Local



. Coal Leases

Occurrence of Coal in New Mexico

Figure 1-24. New Mexico coal leases.

produced in the past, but there are no operations now. The Madrid field in Santa Fe County, the Carthage field in Socorro County, and the Capitan field in Lincoln County had underground mines that supplied coal to the Santa Fe and the Southern Pacific railroads in addition to local demands.

The McKinley mine of Pittsburg and Midway Coal Company, subsidiary of Gulf Oil Corporation, supplies 400,000 tons per year to Arizona Public Service Company's powerplant at Joseph, Ariz. The mine operation is being expanded to increase production to 4,000,000 or more tons per year.

The San Juan Mine of Western Coal Company, a subsidiary of Public Service Company of New Mexico, began stripping and stockpiling coal recently. The coal is for a new powerplant nearing completion in 1973, west of Farmington, New Mexico. The coal will be hauled to the powerplant by truck.

Wyoming. There are 91 Federal coal leases in Wyoming in 1973 located in 10 counties as listed in Table 1-18. Locations of coal fields and leases are shown in Figure 1-25.

Table 1-18
Federal Coal Leases in Wyoming in 1973

County	No. of Leases	Number Producing Strip	Number Producing Underground	Use
Campbell	29	2		1,3
Carbon	16	3	1	1,3
Converse	14	2		1
Fremont		1		1,2,3
Hot Springs	2	1	1	3
Johnson	6			
Lincoln	11	1		1,2,3
Sheridan	5			
Sweetwater	10		1	1,2,3
Uinta	1			
	94[1]	10	3	

[1]Where lease is in more than one county, it is listed in each.

Uses: 1. Powerplant
2. Coking
3. Industrial and local

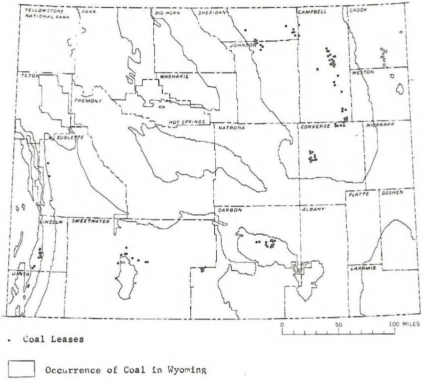


Figure 1-25. Wyoming coal leases.

Five coal regions occur in Wyoming: Big Horn Basin, Green River, Ham's Fork, Powder River, and Wind River. They extend over about half of the State.

Mining started in Wyoming in 1868 and has continued to the present. Most of the past production has come from the Rock Springs field of the Green River basin, the Hanna field, and the Kemmerer field of the Ham's Fork region, and the Powder River Basin. After a low in 1958, production began increasing with a change from underground to strip mining. Most production is now from the Powder River basin, Hanna field, Rock Springs field, and the Kemmerer field.

The land pattern in the latter three coalfields is checkerboarded. These fields are along the Union Pacific Railroad, which received every other section for 20 mi on either side of its right-of-way.

The coalbeds in the Powder River Region are up to 90 ft or more in thickness. It is considered the most important coal region in the State. The coal now being mined is used for powerplant fuel. Futher developments include expansion of existing operations and opening of new mines to provide coal for powerplant use. Contracts have been made or are being negotiated to supply this low sulphur coal to the Midwest, Texas, Gulf States, and the Pacific Northwest.

The Hanna field was opened in 1868 in Carbon, Wyo. when railroad construction reached that area. Mining at Hanna began in 1882 and has continued since. The coalbeds are up to 30 ft thick. The coal has low sulphur and ash content, and is classed

as subbituminous to bituminous with 10,000 to 12,000 BTUs per pound. Mining is both by underground and surface methods. The Hanna field is the site of the Bureau of Mines in-situ coal gasification experiment. In this experiment, a series of holes have been drilled in a circular pattern to a 30-ft seam. The coal is burned in place. Burning is controlled by monitoring the amount of air injected into the center hole. The product gas is withdrawn through one or more of the other holes. Results so far have shown that the product gas has up to 200 BTUs per cubic foot. Regular commercial pipeline gas has from 900 to 1,000 BTUs per cubic foot.

The Rock Springs field in Sweetwater County was opened to supply the Union Pacific Railroad with fuel for steam locomotives. The railroad's change to diesel locomotives in the 1950s eliminated the need for coal. After a 1958 production low, it is increasing. Production is presently used for powerplant fuel and for making synthetic coke. The latter is a new use that has recently been developed. The Rock Springs coal does not coke by the usual methods. But with the development of the synthetic process, a new market is available.

The Kemmerer field in the southwest part of the state, a part of the Ham's Fork region, has numerous seams that were formerly mined underground. Present strip mining is removing coal from nine individual seams. The coal is used for the nearby Naughton powerplant, local industrial and domestic uses, and for a pilot coking plant. The seams are 6 to 100 ft thick. Several seams are mined from the same pit. Further plans indicate that eight other seams may be mined depending on market needs.

The other coal regions, Big Horn basin, and Wind River, have minor production used locally. No increase in production is foreseen for several years for these areas. These basins have coal comparable to quality to the other fields but railroads are not particularly well located for development. While the potential is favorable, more detailed exploration is necessary to determine extent of reserves for new energy developments. Known mineable reserves in excess of 100,000,000 tons are required to justify medium-size, coal-fired powerplants or gasification plants.

In Wyoming, there are 66 preference right coal lease applications.

Forty-eight are in the northern part of the State, mostly in the Powder River region. They cover 82,200 acres and include an estimated 285 million tons of coal recoverable by underground methods and 480 million tons by surface methods.

Seven of the applications are in south central Wyoming. They cover 29,300 acres and include an estimated 785 million tons of recoverable coal.

The remaining 11 preference right coal lease applications are in the southwestern part of the state.

Utah. As shown in Table 1-19, the 195 coal leases in Utah are located in six counties:

Presently only seventeen leases are in production. All production is in the Wasatch Plateau (including Salina), Book Cliffs and Emery coal fields.

All mining in Utah is presently by underground methods.

There are seven major coal fields in Utah that have Federal Coal leases or prospecting permits. They include: Wasatch Plateau (including Salina), Book Cliffs, Kaiparowits Plateau, Emery, Alton, Kolob, and Henry Mountains. Utah has an estimated 10 other coal fields that have limited potential. See Figure 1-26 for major coal areas in Utah.

There is an estimated 200 million tons of strippable coal in the Alton field and the Henry Mountain reportedly has strippable deposits. Existing transportation systems do not exist in the vicinity of the potential strip deposits.

The Book Cliffs coal field in Carbon and Emery Counties is the leading producer. Much of the coal is metallurgical grade and is used by Kaiser Steel Corporation and United States Steel Corporation. Other markets are for powerplants, for industrial use, and for blending with other coking coals produced elsewhere. The field is north and east of Price, Utah, the major community and trading center in the area.

The Wasatch Plateau field is also located in Carbon and Emery Counties generally west of Price. This field is the second major producer in the state. The Huntington Canyon Generating Station will utilize coal from this field. The first 430 megawatt unit is scheduled for completion in 1974. An environmental impact statement is being prepared for the second unit which will be needed on line by 1977.

The Kaiparowits Plateau field, located in Kane and Garfield Counties, has the largest mineral reserve in the State. The coal is of lower quality than

Table 1-19
Federal Coal Leases in Utah

County	No. Leases	No. Producing Strip	No. Producing Underground	Use
Carbon	38		7	1,2,3,4
Carbon/Emery	1		1	1,2,3,4
Emery	44		7	1,2,3
Emery/Sevier	3		2	3
Sevier	12		2	3
Garfield	3			
Iron	2			
Kane	92			
Totals	195		17	

Uses: 1. Powerplants
2. Blending (Coke)
3. Industrial
4. Coking Coal

that from Book Cliffs or Wasatch Plateau but is low sulfur and relatively high quality. Primary interest is in the southeast portion of the field near Lake Powell which will serve as the water source. No mines were producing in the Kaiparowits field in 1973. Several coal fired generating stations have been proposed in the area including the Kaiparowits (Resources) proposal. This station is currently being proposed at 3,000 megawatts. Coal requirements at full development would be about 9 million tons per year.

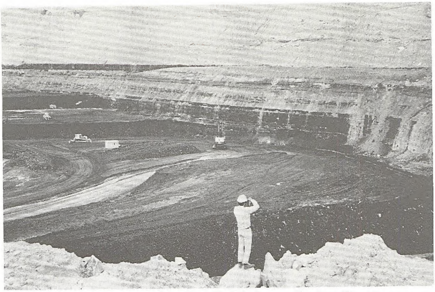
The Emery coal field is located at the south end of the Wasatch Plateau in Emery and Sevier Counties. The area had limited development in its 90 year history. Transportation systems are lacking. The two operating mines ship coal to Price and Salina by truck.

The Henry Mountain coal field located in Garfield and Wayne Counties has no leases, but has 38,775 acres under prospecting permit. Drilling programs are presently underway. The remoteness of the area and lack of a transportation system and uncertainty of water are limiting factors to coal development in this field.

The Alton and Kolob coal fields lie west of the Kaiparowits Plateau. The Alton field has more than 26,500 acres of existing federal lease. The coal is being considered as a fuel source for powerplants in southwest Utah and southern Nevada. The field is attractive because of location and the existence of an estimated 200 million tons of strippable coal. Lack of water and lower quality coal in comparison to the Kaiparowits Plateau field are factors that will hinder development.

The west portion of the huge southern Utah coal deposits is the Kolob field. The area produced fuel for local consumption until 1969. The field has limited potential because the coal is relatively thin bedded and badly split. Sulfur content is in excess of 1.5 percent. The field has limited potential under present economic and environmental conditions.

Several other smaller fields produced coal for local use, but most are no longer in operation. The low interest is usually due to: potential reserves too small; seams dip steeply;



Big Horn Mine No. 1 in Wyoming's Big Horn Coal Region near Sheridan, Wyoming.

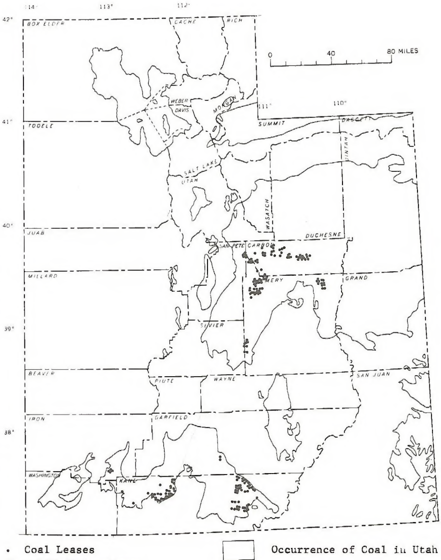


Figure 1-26. Utah coal leases.

coal seams are leaticular; have high ash content or sulfur; and have low BTU value.

Development of Utah coal during the remainder of the century can be expected to continue in the Book Cliffs and Wasatch Plateau. The Kaiparowits Plateau will become the largest producer if the proposed electric generating complexes are developed.

Montana, The 17 Federal coal leases active in Montana in 1973, are located in seven counties, as listed in Table 18. Areas underlain with coal and the locations of leases are shown in Figure 1-27.

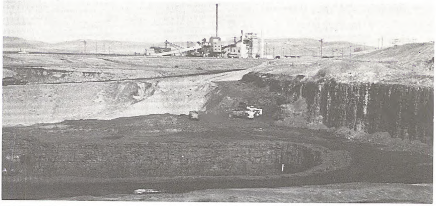
The coalfield of major interest is in the southeastern part of the state. The coal beds are in the Tongue River Member of the Fort Union Formation. They are up to 60 ft or more thick. All coal included in Federal leases is strip mined. The leases in Big Horn County are all located in the southeastern part near the Montana-Wyoming state line. The three leases in Rosebud County are near Colstrip, Montana, with part of one of the leases extending westward into Treasure County.

About 70 percent of the land in eastern Montana is non-Federal but the BLM has jurisdiction over 55 percent of the mineral estate.

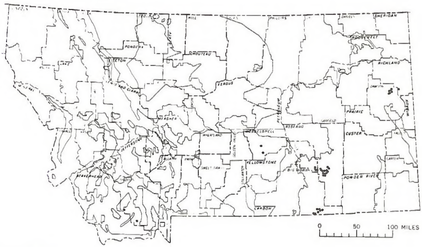
One small strip mine is operating in Musselshell County, south of Roundup. It supplies local demand for domestic space heating use.

In addition to existing leases, there are 18 applications for preference right leases and four existing prospecting permits. The prospecting permits were issued several years ago, and the holders can be expected to file for preference right leases upon discovery of workable coal deposits.

In the past, considerable underground mining was done in the other coalfields in the state: Bull Mountain, Lewistown, Great Falls, Redlodge, etc. In 1973, there was only one operation on a Federal lease in those fields, the strip mine in the Bull Mountain field. These fields have one or more of the following drawbacks: underground opration, high sulphur and ash content, steeply dipping seams, low reserves, poor accessibility, and difficult mining conditions.



Wyodak Mine and Powerplant near Gillette in Wyoming's Powder River Coal Region.



Coal Leases

Occurrence of Coal in Montana

Figure 1-27. Montana coal leases.

Table 1-20
Federal Coal Leases in Montana in 1973

County	No. Leases	No. Producing Strip	No. Producing Underground	Use
Big Horn	8	1		1
Dawson	2			
Madison	1			
Musselshell	2	1		2
Richland	1	1		1
Rosebud	3	2		1
Treasure	1			
Total	18[1]	5		

[1] Where lease is in more than one county, it is listed in each.

Uses: 1. Powerplant
2. Local

Indications are that strip mining of Federal coal in Montana will increase during the next 20 years to supply plants generating electricity.

North Dakota. The 20 Federal coal leases active in North Dakota in 1973 are located as shown in Figure 1-28 and Table 1-21.

The coal-bearing Fort Union Formation underlies the western half of the state. Most of the surface ownership is private, but about a quarter of the mineral estate is Federally controlled. All coal included in Federal leases is strip mined.

The four operating companies have seven mines located in Bowman, Burke, Mercer, Oliver, and Ward Counties.

While present use of the coal is for powerplant fuel, future demand is expected for use in gasification. The lignites of the Fort Union Formation are susceptible to gasification. In anticipation of this use, large blocks of North Dakota lignite have been assembled by the operating companies and others. An economic gasification unit of 250,000,000 cubic feet of pipeline gas per day would require 10,000,000 tons of lignite per year, or 500,000,000 tons for a 50-year supply. Eight units are proposed and up to 20 units may be feasible, depending on available water and recoverable coal.

Most of coal being committed to gasification is privately owned. Three pending Federal lease applications cover 31,953 acres of government coal.

Oklahoma. The area underlain by coal in Oklahoma is given as 14,550 square miles. It is located in the northeast portion of the State and is part of the Western Interior Basin.

The Bureau of Land Management administers 374,000 acres of coal lands located in the east-central portion of the State, of which only a small portion of the surface is federal. The 53 leases are within six counties as shown in Table 1-22. As of March 1973, only two mines were operating on these federal leases.

The coal in these counties is in a series of anticlines and synclines. The accessible coal is limited because of the folded rock and steeply dipping formations. Only the coal along a narrow belt parallel to the outcrops is mined.

The coal seams are two to six feet thick and are of high quality. Much of the coal is of coking quality. The federal acreage under BLM administration is located in a one or more mile wide band along the outcrops. Mining has been done since 1880 and much of the outcrop coal has been taken. Consequently, only the thin seams and deep coal remain.

The deep coal is costly and difficult to mine. The last underground operation closed in 1971 because of high cost and difficult mining operations. Underground operations are noted for methane gas, poor roof conditions, irregular and undulating roof and floor.

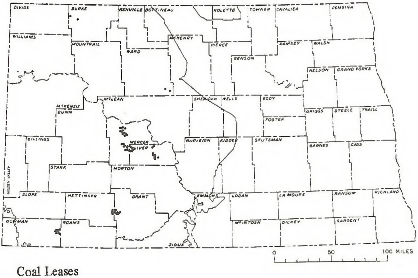
The two strip operations are mining a 20-24 inch seam. Up to 120 feet of overburden is removed to take this

Table 1-21
Federal Coal Leases in North Dakota in 1973

County	No. Leases	No. Producing Strip	No. Producing Underground	Use
Bowman County	2	1		1
Burke	2	1		1
Grant	3			
Hettinger	2			
Mercer	7	3		1
Oliver	4	3		1
Ward	2	1		1
Williams	2			
Total	24[1]	9[2]		

[1]Where lease is in more than one county, it is listed in each.
[2]Mines operating in more than one county are listed in each.

Uses: 1. Powerplant



Coal Leases

Occurrence of Coal in North Dakota

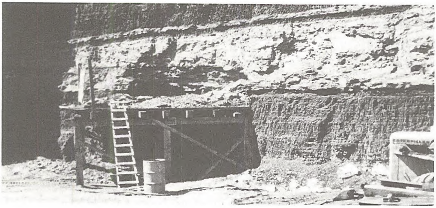
Figure 1-28. North Dakota coal leases.

Table 1-22
Federal Coal Leases in Oklahoma in 1973

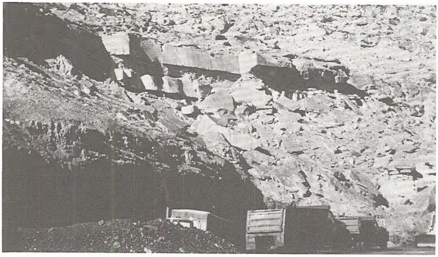
County	No. Leases	No. Producing Strip	No. Producing Underground	Coal Use
Atoka	1	0	0	
Coal	1	0	0	
Haskell	12	2	0	1,2,3, & 4
Latimer	6	0	0	
Leflore	35	0	0	
Pittsburgh	6	0	0	
Total	61*	2	0	

*Where lease falls in more than one county, it is listed in each county.

Uses:
1. Powerplant
2. Export
3. Blending (Coke)
4. Coking Coal



Kaiparowits Plateau Coal Field – Test entries on major coal bed near proposed power plant.



Kaiparowits Plateau Coal Field – Sandstone overburden covering major coal bed.

coal. It has coking qualities and has a market value of $15 per ton. Production for 1972 is given as 409,000 tons.

In the area of the strip mining, the seam has a dip of three to six feet per hundred. Thus, coal can be taken along a belt one quarter to three quarters of a mile down dip from the outcrop.

Interest has increased during 1973 for the government coal, particularly to those areas having some strippable coal of metallurgical quality.

Alabama, Kentucky, and Ohio. There is relatively little Federal land in the eastern states. Those states in the Appalachian region have less than 6-1/2 percent Federal lands. These Federal lands have been acquired through purchase by a Federal agency for a special use, i.e., national forest, flood control, national park, military use, etc.

In Alabama, some lands were patented but reserved minerals, including coal, to the United States. Much of the land is in isolated parcels, and the Federal Government may only have surface rights. If mineral rights were obtained, they may not be available for leasing because mineral development is not compatible with the present use. When leasing is permissible, leases may be obtained from the BLM. Three existing leases in the Eastern and Interior Coal Provinces are located as follows: one of 282 acres in McCeary and Whitley Counties in southeastern Kentucky; one in Lawrence County, Ohio, of 144 acres; and one of 200 acres in Walker and Tuscaloosa Counties, Alabama, northwest of the center of the State.

Three competitive lease applications pending in 1973 were in Illinois, Pennsylvania, and Alabama. One prospecting permit for 880 acres is in West Virginia.

When leasing is permissible and mining is approaching an isolated tract, it is usually desirable to lease to the mining operator. Otherwise the coal would be lost, since the amount of coal in the tract is usually insufficient for an independent mineable unit. Leasing would be under the short-term criteria set forth by the Secretary. Competitive bidding would be required and an environmental analysis made. Protective and rehabilitation requirements would be part of the lease terms.

In BLM's Eastern States Office, 7981 Eastern Avenue, Silver Spring, Maryland, 20910, administers these leases and permits.

Table 1-23
Production and Income From Federal Coal Leases, Prospecting Permits, and Licenses[1]

	1957		1962		1967		1972	
	Tons	Dollars	Tons	Dollars	Tons	Dollars	Tons	Dollars
Alabama					134,164	20,495		100
Alaska	739,462	97,473	828,179	115,806	258,233	44,495	624,711	91,314
California				240		80		320
Colorado	530,648	77,235	500,000	87,654	2,030,000	346,875	2,386,000	509,911
Idaho		3,688						
Illinois		158	1,092	156		18,390		
Kentucky	21,370	3,224	13,398	4,295	123,466	197,756	363,689	95,135
Montana	25,385	14,537	155,598	15,328	115,000	27,324	81,562	42,500
New Mexico	33,856	4,490	103,750	13,551	26,750	158,629	206,217	102,111
North Dakota	412,080	47,107	366,379	38,004	590,000		1,360,940	202,276
Ohio						65,297		72
Oklahoma	420,139	90,558	248,699	72,253	143,831	4,167	410,427	153,356
Oregon	325	87	232		424		238	2,874
Utah	2,957,352	408,537	2,722,644	541,886	1,648,801	414,252	1,979,975	568,805
Washington		500		70		280		522
Wyoming	441,544	58,364	1,029,171	128,325	2,111,890	808,322	2,808,652	578,120
Others	125	53						220
Totals	5,552,286	806,011	5,969,142	1,017,568	7,182,559	2,167,471	10,222,411	2,347,636

[1]From Public Land Statistics, Bureau of Land Management

Table 1-24
Production and Income from Federal Coal Leases, Prospecting Permits, and Licenses, All States

Year	Tons	Dollars
1957	5,522,286	$ 806,011
1958	5,292,485	788,096
1959	5,016,167	957,048
1960	5,447,666	751,789
1961	5,419,326	830,949
1962	5,969,142	1,017,568
1963	5,175,348	912,154
1964	5,460,084	997,613
1965	6,166,066	1,149,021
1966	6,093,642	1,944,960
1967	7,182,559	2,167,471
1968	7,046,963	4,004,031
1969	7,346,070	2,042,048
1970	7,339,775	2,096,826
1971	10,250,468	9,836,313
1972	10,222,411	2,347,636

Source: Geological Survey, Conservation Division

Table 1-25
Bonus Bids on Federal Competitive Coal Lease Sales 1957 Through 1972

Year	Acres	Bonus Bids	Dollars Per Acre
1957	3,993	$ 6,297	$ 1.58
1958	15,375	19,176	1.25
1959	8,085	224,179	27.73
1960	4,358	9,055	2.08
1961	12,733	20,531	1.61
1962	38,976	202,404	5.19
1963	20,780	143,023	6.88
1964	10,788	39,532	3.66
1965	23,364	146,358	6.26
1966	44,894	753,727	16.79
1967	43,885	721,294	16.44
1968	88,037	3,077,736	34.96
1969	–	–	–
1970	18,493	370,395	20.03
1971	22,546	7,626,954	338.28
1972	–	–	–

Source: Geological Survey, Conservation Division

Production and Receipts. Table 1-23 shows annual production and income from Federal coal by State. Income consists of payments for rentals, royalties, filing fees, and bonus bids at competitive coal lease sales.

Production from Federal coal lands was fairly constant at about five and one-half million tons per year from 1957 until 1965. It rose to 7 million tons in 1967 and remained at about 7 million tons until 1971 when there was a sudden increase to almost 10 million tons. New mines in Wyoming contributed over one million tons of the increased production in 1971.

Income from Federal coal lands averaged about $800,000 from 1957 through 1961. It began to rise in 1962 and reached $2 million in 1967. Since 1967 total income varied from $2 million to almost $10 million.

The rise in production after 1965 and the rise of income after 1961 were caused by entrance of major eastern coal companies into western coal areas in the late 1950s and early 1960s.

The erratic nature of income after 1967 is attributable to bonus bids for competitive coal lease. Very high unit bids resulted when air quality standards increased the desirability of using low sulfur western coal. Another factor was the entry of major oil companies into the bidding. No coal lease sales were held in fiscal year 1969, nor since June 30, 1971.

Trends in total Federal coal production and income, bonus bids per acre, and production and income by State are shown in Tables 1-23, 1-24, and 1-25. Figure 1-30 is a graph of production and income.

Coal Reserves Under Federal Leases and Applications. To estimate how much Federal coal is presently committed to lease, it is necessary to consider active coal leases, preference right applications for coal leases, and prospecting permits. Under procedures in effect, when the granting of prospecting permits was halted on February 13, 1973, a prospecting permittee could expect to be granted a preference right coal lease if he discovered coal of commercial value. Thus, it can be anticipated that coal may be produced from prospecting areas. Also, approval of preference right applications has generally been granted up to now, so coal in areas

Table 1-26
Recoverable Coal Reserves held Under Federal Lease

State	Number of Leases	Reserves Strippable Million Tons	Reserves Underground Million Tons	Total Reserves Strippable & Underground Million Tons	Total Acres Leased Thousand Acres
Colorado	112	273	1,377	1,650	122.1
Montana	17	1,181	0	1,181	36.2
New Mexico	28	278	57	335	41.0
North Dakota	20	268	0	268	16.4
Utah	195	265	3,319	3,604	266.7
Wyoming	91	8,361	704	9,065	200.0
Other States[1]	67	14	226	240	95.9
Totals	530	10,660	5,683	16,343	778.3

[1] Other states are Alabama, Alaska, California, Kentucky, Ohio, Oklahoma, Oregon and Washington.

Source: BLM, Coal Lease Analysis, 1974.

Table 1-27
Recoverable Coal Reserves held Under Federal Preference Right Coal Lease Application

State	Total Reserves Number of Applications	Million Tons	Acres
Colorado	34	890	68,565
Montana	8	792	26,306
New Mexico	27	562	75,510
North Dakota	0	0	0
Utah	14	599	39,091
Wyoming	18	7,445	24,087
Other States[1]	9	20	17,833
Total	110	10,308	251,392

[1] Other States include Alabama, California, Kentucky, Ohio, Oklahoma, Oregon, Washington and West Virginia. Alaska acreage and number of applications included. Alaska reserves not available.

Source: BLM, USGS.

covered by such applications also may be considered to be committed for extraction.

Slightly more than 16 billion tons of Federal coal are "recoverable" under leases active in 1974, according to estimates in Table 1-26, Recoverable Coal Reserves Held Under Federal Leases. Over 10 billion tons in addition can be recovered from areas for which preference right applications for coal leases have been filed, as shown on Table 1-27, Recoverable Coal Reserves Held Under Federal Preference Right Coal Lease Applications. It must be emphasized, however, that total recoverable reserve data include quantities of material which may not be economic due to size of the lease unit, location, transportation costs, or other factors which affect the development of the coal.

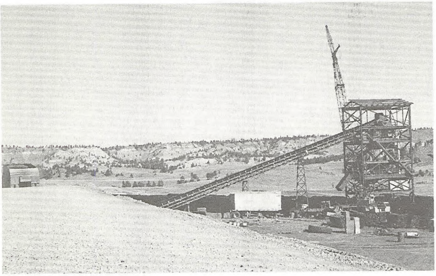
Tables 1-26 and 1-27 do not show the coal reserves that are committed as a reserve for a proposed or operational plant. These committed reserves must be subtracted from the total reserve figures to get an idea of what coal is available for future use. For example, the Bureau of Mines has projected that 36 coal gasification plants will be in operation by 1985. Each of these plants will require about 8 million tons per year, or 320 million tons for a 40 year reserve. This would mean that 12.8 billion tons of coal would be set aside for the gasification plants. Consumption from power plants proposed or in operation that do or will depend on Federal coal from the six Rocky Mountain States, is over 80 million tons per year. Again, for a 40 year reserve, this is 3.2 billion tons not available for other uses. The above estimated committed reserves for these two types of operations would be over 16.0 billion tons through the next 40 year period. However, not all of these committed reserves would come from Federal leases.

Additional commitments have or are being made by companies holding coal leases in the Rocky Mountains to supply markets in the Midwest, Pacific Northwest, and Gulf Coast. The amount of coal required will depend on future energy policies, especially considering domestic self-sufficiency for energy resources.

Many other factors need to be considered in analyzing the need for Federal coal leasing. For example, the geographic location of the lease tracts. Transportation costs for most coal markets are the limiting factors in determining the economic viability of coal reserves. Transportation has generally comprised from one-third to one-half the delivered cost of coal. (*Railroad Progress in the Transportation and Handling of Bulk Materials.* Transactions of the Society of Mining Engineers, v. 252, No. 1, March 1972, p. 21.) Longer distances mean higher costs for transportation. An economically minable lease may not be produced because it is too far from its potential market to be competitive with coal reserves located nearer the point of consumption.

Because of the transportation costs, the geographic location of the noncommitted reserves relative to the consuming market is a critical factor when considering the availability of the noncommitted coal reserves.

Peabody Coal Company's tipple at the Big Sky Mine near Colstrip, Montana, crushes, weighs and loads 100 ton cars of a unit train. This is one of the biggest potential mining operations in the Fort Union Formation.



Detail of above.

Nearness to transportation outlets is another geographical factor which is vitally important to the development potential of these reserves. In many areas, e.g., certain leased areas in Utah or New Mexico, the noncommitted reserves are isolated from a transportation outlet. These reserves could only be used for onsite development even though potential export markets exist. This is particularly true in the southwestern United States.

Further, it must be recognized that rather long lead times are required before leased reserves can result in electricity at the bus bar or gas at the plant gate. Average lead times required for the development of coal resources in certain key markets are as follows:

KEY MARKET	*LEAD TIME*
Local and Export	5 years. – Lead time required to new coal mine (National Coal Association).
Electric Generation	8 years. – Lead time required before generation is needed for a base-load coal plant (unpublished NERC report and based on information compiled by Western Systems Coordinating Council).
Synthetic Gas	10 years. – Maximum time required from lease issuance to gas at plant gate (personal communication from Bureau of Mines).

Finally, during the development of reclamation requirements for individual leases it is possible that surface disturbance will not be permitted on portions of the lease for environmental reasons.

Historically, when a coal deposit is mineable by underground methods about 50 percent will be recovered. If the coal is mineable by surface methods, the extraction will be about 85 percent. These estimates are primarily based on conditions and experience in the Eastern and Interior Coal Provinces. Recovery by surface mining in the Northern Great Plains and Rocky Mountain Coal Provinces probably will be close to 85 percent, also. However, recovery by underground mining methods may be less, because, paradoxically, the coalbeds are thicker. When coal beds are more than 15 ft thick recoverability generally decreases with increasing thickness, because of difficulties in supporting the overburden.

In the tabulations, tonnage figures represent recoverable reserves that could be removed from the coal lands with present technology. Mining losses have been deducted from the reserves given in the tables. Reserves were calculated by Federal geologists and engineers using data from published sources, government records, and leases and permittee exploration and mining information.

Factors limiting coal reserves vary with location and nature of the coal seams. Generally, coalbeds greater than 5 ft in thickness and under less than 1,000 ft of cover were considered mineable. The thinner of two underground mineable beds within a 40 to 50 ft interval was excluded from reserves. Recoverability factors considered included pitch, rock partings, marketability, bed thickness, mining

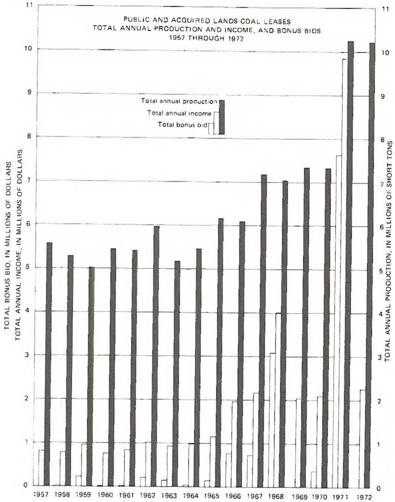


Figure 1-29. Public and acquired lands coal leases total annual production and income, and bonus bids, 1957 through 1972.

experience and technology, depth, and roof and floor conditions. Generally, surface mineable reserves represent all coalbeds 5 ft thick or thicker, lying within 150 to 200 ft of the surface in an area that could be surface mined by methods other than augering or contour stripping. Acres mineable by strip and underground methods are omitted. Except for states showing no underground mineable reserves, it can be assumed that most of the land contains multiple coalbeds and, therefore, underground mining could occur on most of the lands listed under total acres. More than 300,000 acres of leased and preference right lease application lands could be mined by stripping.

Table 1-29 shows prospecting permits acreages. Tonnages of coal reserves has not been calculated for the permit lands.

Table 1-30 is a summary of data showing total acreages and total coal reserve tonnages in the present leasing program.

Projections of expected production, based on these estimates of committed Federal coal reserves, are shown in Table 1-28, Recoverable Coal Reserves on Federal Lands Committed to Leasing and Projected Production From Federal Coal Lease Lands for 1975 through 1980. The projections of production were estimated by Geological Survey mining supervisors who maintain close contact with lessees, coal consumers, and public agencies concerned with coal production.

Potentially Leaseable Coal. Although there are large tracts of Federally managed surface land, the Federal mineral estate and particularly the Federal coal resource is diversified and fragmented. In some cases only a partial interest is retained (for example: 3/16 interest). For this reason no precise national inventory of Federal coal has been completed. However, they are being prepared for specific areas.

Table 1-31 gives the general extent of Federal coal-bearing lands in eight principal states. It was compiled from tallies and estimates and indicates the ownership pattern in potential coal-leasing areas. The largest Federal coal areas are in Montana and Wyoming with lesser amounts in Colorado, New Mexico, North Dakota, and Utah. Although Alaska with 22 million acres appears to be the largest, pending claims under the Native Claims Act and selections by the State of Alaska will probably transfer a large portion of this out of Federal jurisdiction. Mineral lands are being selected to satisfy the claims.

No tabulations of Federal coal reserves have previously been completed, partly because of the complex ownership problem and partly because of the lack of detailed geologic information in all areas. A rough approximation can be made from the fact that the published calculated reserves for a given area are generally proportionate to the area distribution of coal. Also, it was assumed that the ratio of Federal to non-Federal ownership that exists in the general coal-bearing areas would exist in the reserve areas.

Using these premises, Table 1-32 was compiled showing the tons of strippable and underground coal by state and the approximate value of the coal in Federal ownership based on present prices. It is emphasized that these figures are very general are given only to show the magnitude and relationships in different areas.

Excluding Alaska again, it is apparent that interest in future Federal coal leasing will generally focus around coal deposits in Montana, Wyoming, Utah, and Colorado and to a lesser extent, North Dakota and New Mexico.

The acres of Federal coal bearing lands in Table 1-31 is 92.1 million. In Table 1-15 the acres of coal under Federal lease for the same eight States is 771,737 or less than 1%. Much of

Table 1-28
Recoverable Coal Reserves on Federal Lands Committed to Leasing and Projected Production from Federal Coal Lease Lands for 1975 through 1990

State	Total Recoverable Tons Committed to Lease Million Tons[1]	Production 1975 Estimated Million Tons Per Year	Production 1980 Estimated Million Tons Per Year	Production 1985 Estimated Million Tons Per Year	Production 1990 Estimated Million Tons Per Year
Colorado	2,540	8.4	21.6	32.0	39.2
Montana	1,973	12.0	24.6	47.2	62.3
New Mexico	897	2.1	3.5	4.7	5.3
North Dakota	268	3.0	6.3	27.4	41.5
Utah	4,203	3.2	20.2	21.7	35.3
Wyoming	16,510	15.5	65.0	84.5	97.7
Other States[2]	260	2.6	2.1	2.7	3.4
Total	26,651	96.8	143.3	220.2	284.7

[1]Total surface and underground minable recoverable coal under Federal coal lease and preference right lease applications for which coal reserves have been calculated. Includes no reserves for coal prospecting permits.

[2]Other states include Alabama, Alaska, California, Kentucky, Ohio, Oklahoma, Oregon, Washington and West Virginia.

Source: BLM January 27, 1974, Coal Lease Analysis, 1974.

the 91 million acres of unleased land is uneconomical to mine with the present technology, but will be available for future needs.

Tables 1-33 and 1-34 show alternative rates of coal development in the Northern Great Plains area that have been prepared by the Northern Great Plains Resource Program. These alternatives are included as examples of quantified production data which will be included in site-specific environmental impact statements. It is, of course, not possible to accurately quantify environmental impacts on the basis of generalized production projections. Quantified impact data will be included in all site-specific environmental impact statements. These production projections are based upon three scenarios termed Coal Development Potential (CDP).

Table 1-29
Prospecting Permit Acreage

State	Number of Permits	Acres
Alaska	1	160
Colorado	7	29,420
Montana	4	10,878
New Mexico	2	2,080
Utah	21	55,988
Wyoming	36	78,209
Oklahoma	4	5,707
West Virginia	1	879
Total	76	183,321

Source: BLM, Sept. 12, 1974, USGS, 1973.

CDP (I) is the minimum reasonable rate of coal production that is sufficient to meet existing contractual agreements and increases in regional demand for coal. CDP (II) is that which can be expected based on the rate of consumption and production forecast in "United States Energy Through the Year 2000" by West and Dupree for the Department of the Interior December 1972. CDP (III) is the maximum contribution that NGP coal might reasonably be expected to make in alleviating shortages in the supply of imported oil and gas and domestic nuclear electrical generation.

Table 1-30
Summary – Present Coal Program, Lands and Coal Reserves

	Number	Total Reserves (million tons)	Total Acreages (thousand acres)
Active Coal Leases	530	16,343	778.3
Preference Right Coal Lease Applications	110	10,308	251.4
Active Coal Prospecting Permits	76	[1]	183.3
Total	716	26,651	1,213.0

[1]Coal reserve data not available
Source: BLM, USGS.

Table 1-31
States with Major Federal Coal Acreages

State	Federal Coal[1,2] Million Acres	Federal Coal[1,2] Percent	Non-Federal Coal Million Acres	Non-Federal Coal Percent	Total[2,3] Million Acres
Alaska	23.4	97	.8	3	24.2
Colorado	8.7	53	7.9	47	16.6
Montana	24.6	75	8.2	25	32.8
New Mexico	5.5	59	3.9	41	9.4
North Dakota	5.6	25	16.8	75	22.4
Oklahoma	.4	4	8.9	96	9.3
Utah	4.1	82	.9	18	5.0
Wyoming	11.8	65	10.7	35	30.5
Totals	92.1		58.1		150.2

[1]Southwestern Energy Study, Appendix J, p 48, 1972.
[2]BLM State Office Estimates
[3]Averitt, Paul, Coal Resources of the U.S., January 1, 1967: U.S. Geological Survey Bulletin 1275, p. 32, 1969.

Table 1-32
Estimate of Federal Coal Resources and Values in Principal Leasing States for Surface and Underground Deposits

		Federal Resources (1) (2)	Federal Resources (3)	Total Value of Federal Resources (4) (5) (6)
		Million Short Tons	Million Short Tons	Million Dollars
Alabama	– Surface	134		
	Underground	7,537		
Alaska	– Surface	4,411	4,279	
	Underground	60,629	58,810	466,228
California	– Surface	25		
	Underground	294		
Colorado	– Surface	500	265	
	Underground	39,829	21,111	125,050
Montana	– Surface	6,897	1,700	
	Underground	103,940		
New Mexico	– Surface	2,457	1,450	
	Underground	28,239	16,661	53,123
North Dakota	– Surface	2,075	519	
	Underground	173,240	43,310	344,167
Oklahoma	– Surface	111	4	
	Underground	1,529	61	410
Oregon	– Surface			
	Underground	167		
Utah	– Surface	150	123	
	Underground	11,714	9,605	70,820
Washington	– Surface	135		
	Underground	2,984		
Wyoming	– Surface	13,971	6,706	
	Underground	46,357	22,251	87,480

[1]U.S. Bureau of Mines, I.C. 8531: Strippable Reserves of Bituminous Coal, and Lignite in the United States, p. 23, 1971.
[2]Averitt, Paul, Summary of U.S. Mineral Resources, U.S. Geological Survey, Survey, p. 820, 1972.
[3]Computed from estimated ownerships ratios given in Table 30.
[4]Synthetic Fuels, Cameron Engineering, Vol. 9, No. 2, June 1972, p. 4-31.
[5]1972 Keystone Coal Industry Manual, McGraw-Hill, p. 429.
[6]Bituminous Coal Facts, 1972, National Coal Association, p. 68.

*Refers to coal that can be recovered with existing technology and equipment or that may be available in the foreseeable future. Only those coals less than 1,000 ft in depth are included. Strippable coal resources are adjusted to conform to the stripping ratio which varies by area. Coal that cannot be mined because of proximity to natural or manmade features is excluded.

Table 1-33
Effect of Development in the Northern Great Plains

	1970	1971	1975	1980	1985	2000	2035
New Employment (thousands)	0	–	–	–	–	–	
CDP I	0	–	–	17	8	18	
CDP II	0	–	–	23	57	85	
CDP III	0	–	–	84	99	175	
Population increases (thousands)							
CDP I	0	–	–	56	36	82	
CDP II	0	–	–	65	140	245	
CDP III	0	–	–	190	234	516	
Coal mined (MST/yr)							
CDP I	–	21.3	52	91	108	144[1]	
CDP II	–	21.3	52	107	192	362[1]	
CDP III	–	21.3	52	160	382	977[1]	
Number of facilities							
CDP I							
Export mines	–	10	–	14	15	18	
Powerplants (MW in parentheses)	–	0	–	12 (5,613 MW)	14 (6,613 MW)	20 (13,100 MW)	
SNG plants	–	0	–	0	0	0	
CDP II							
Export mines	–	10	–	16	20	24	
Powerplant (MW in parentheses)	–	0	–	12 (5,613 MW)	14 (6,613 MW)	25 (19,400 MW)	
SNG plants	–	0	–	0[2]	7[2]	16	
CDP III							
Export mines	–	10	–	16	26	64	
Powerplant (MW in parentheses)	–	0	–	12 (5,613 MW)	14 (6,613 MW)	25 (19,400 MW)	
SNG plants	–	0	–	7	13	41	
Water need (conversion only – thousands of acre feet)							
CDP I							
High use estimate	–	–	–	98	119	243	
Medium use estimate	–	–	–	62	75	153	
Low use estimate	–	–	–	28	33	66	
CDP II							
High use estimate	–	–	–	98	329	843	
Medium use estimate	–	–	–	62	142	381	
Low use estimate	–	–	–	28	75	139	
CDP III							
High use estimate	–	–	–	308	719	1,593	
Medium use estimate	–	–	–	129	263	618	
Low use estimate	–	–	–	70	153	343	
Land disturbance (thousands of acres)							
CDP I	–	–	–	8	19	103	242
CDP II	–	–	–	8	31	210	671
CDP III	–	–	–	20	70	397	1,473

[1]Includes supply to 6,700 MW of coal-fired electric plants outside of 63-county study area but within the Sates and coal exported to other States.
[2]Present industry trends indicate no operating gasification plants by 1980.

Source: The Northern Great Plains Resource Program.

Table 1-34
Coal Production from Each NGP State for Each CDP

	Million short tons				
	1971	1975	1980	1985	2000
Montana					
Low (CDP I)	7.1	20	34	39	58
Intermediate (CDP II)	7.1	20	41	75	133
High (CDP III)	7.1	20	64	153	393
Wyoming					
Low (CDP I)	8.1	23	37	43	55
Intermediate (CDP II)	8.1	23	47	73	110
High (CDP III)	8.1	23	54	153	386
North Dakota					
Low (CDP I)	6.1	9	19	26	33
Intermediate (CDP II)	6.1	9	19	44	119
High (CDP III)	6.1	9	42	76	198

Source: The Northern Great Plains Resource Program.

Chapter Two

Description of the Environment

1. Description of the Environment

Nearly all Federal coal resources are found in the Northern Great Plains Coal Province and the Rocky Mountain Coal Province. Of a nationwide total of 778,000 acres of Federal Coal Leased, 681,000 acres have been leased in these two provinces. The other four coal provinces in the country contain relatively minor amounts of Federal coal. The environment of each of these is described only briefly and in the broadest terms, since environmental analyses in these diverse coal provinces will be prepared on a case-by-case basis prior to issuance of leases.

The two major coal provinces of importance for Federal coal leasing are described. Environmental components described include geology, topography, climate, hydrology, soils, vegetation, and wildlife. Current land uses are described in terms of agriculture, forest products, livestock range, wild horse and burro habitat, watershed, mining, recreational, and urban uses.

Human population patterns and considerations are described as to their social, economical, political, and cultural or religious conditions. Less tangible, but very important human value resources of the environment are the esthetic, historic, archeologic, and geologic features on and adjacent to Federal lands in the coal provinces.

Ecological Interrelationships. All organisms share a common need to satisfy their requirements for continuing life and reproducing themselves (e.g., food, shelter, moisture, and respiratory gases). A vast array of interactions serves to meet these environmental dependencies. These interactions include relationships between the individual organism and organisms of the same and of different kinds, and between the organism and its nonliving environment (Kormondy, 1969).

Abiotic (nonliving) Environment. Ecological interrelationships occur in physical and chemical settings of nonliving or abiotic environmental components. These include basic chemical elements and compounds such as water and carbon dioxide, calcium and oxygen, carbonates and phosphates, and organic compounds which are the byproducts of organism activity or death. There are also such physical factors and gradients as moisture, winds, air currents, and solar radiation with its concomitants, light and heat. Within this abiotic environment, living organisms interact in a fundamentally energy-dependent fashion (Kormondy, 1969).

Biotic (living) Community. Living organisms, plants, animals and microbes, form biotic communities that occupy a complex of environments. These organisms compete for the life-sustaining light, warmth, atmospheric gases, water, and nutrients provided by the abiotic environment. Each in its turn creates part of the environment affecting the others (Spurr, 1964.) These organisms are of two major kinds, autotrophic and heterotrophic. Autotrophic organisms are self-nourishing; heterotrophic organisms meet nutritional needs by feeding on other organisms. More specific classification is according to function.

Producers are autotrophic organisms that are able to manufacture food from simple inorganic substances (Odum, 1959). In this process, radiant energy (sunlight) is used to convert carbon dioxide, water, and nutrient minerals into carbohydrates that serve as food for the producer's own growth and metabolism (Kormondy, 1969). Producers are largely the green, chlorophyll-bearing plants: these trees of a forest, the grass of a field, the algae of a pond. Of less significance as producers are phyotosynthetic and chemosynthetic bacteria.

Consumers are heterotrophic organisms, chiefly animals, which ingest organic matter. A primary consumer (herbivore) derives its nutrition directly from plants; a secondary consumer (carnivore) obtains its nutrition indirectly from the producer by feeding on the primary consumer. Included in the consumer class are mammals, birds, reptiles, fish, worms, parasitic fungi, and certain bacteria.

Decomposers are heterotrophic organisms which reduce, or break down, complex organic compounds, absorb some of the products of decomposition, and release the remainder in simple forms usable by the producers. Bacteria and fungi are the chief decomposers, but such macro-organisms as millipedes, earthworms, and mites also reduce complex organic compounds.

Ecosystems. A general abiotic environment and associated biota (a general biotic community) together comprise an ecological system, or ecosystem (Kormondy, 1969), in which living organisms and nonliving matter interact to produce an exchange of materials between the living and nonliving parts. An ecosystem, then, is a complex of vegetation, bacteria, fungi, protozoa, arthropods, various other

invertebrates, vertebrates, oxygen, carbon dioxide, water, minerals, and dead organic matter. Such a complex is never completely in balance; an ecosystem is constantly changing diurnally, seasonally, and with long-term climatic cycles (Spurr, 1964).

Resisting sudden, radical changes are checks and balances, forces and counterforces, that maintain a semblance of equilibrium between organisms and environment, thus tending to stabilize the ecosystem as a whole. These factors are known as homeostatic mechanisms (Odum, 1959). These include processes that regulate the storage and release of nutrients, the growth of organisms, and the production and decomposition of organic substances. As an example of the function of these mechanisms, consider the rate of photosynthesis of a whole biotic community. This may be much less variable than that of individual organisms or species within the community because, when one individual or species slows down its rate, another may accelerate in a compensatory manner. As another example, when treated sewage is discharged into a stream at a moderate rate, the aquatic ecosystem is able to purify itself by homeostatic processes and to restore its previous quality within a few miles downstream. These mechanisms are not yet fully understood, but their important role in maintaining a natural ecological balance is known and recognized.

While the abiotic (nonliving) environment controls the activities of organisms, the latter influence and control the abiotic environment in many ways. Changes in the physical and chemical nature of inert materials are constantly being effected by organisms that return new compounds and isotopes to the nonliving environment. Such organic influence can be very strong and its products significant; e.g., plants build soils that are radically different from the original substrates (Odum, 1959).

When the environment changes as a result of actions of organisms that increase soil fertility, or because of decreased light intensity, climatic variation or any other modification, conditions may become favorable for some organisms other than those already present. There may then be replacement of one species by another or of one biotic community by another, with more replacements following in later succession (Spurr, 1964).

Radiant energy, in the form of sunlight, is the ultimate source of energy for any ecosystem. Energy flow, the nutrient cycle, and the hydrologic cycle are fundamental processes that give life to an ecosystem.

Ecosystems in the Soil. Wilde (1958) summarizes the importance of soil organisms by stating that they are essential to the existence of plants and animals. Organisms are a vital part of the cyclic pattern of matter in nature and are the tools with which nature fashions soil from the lifeless geologic matrix and plant and animal residue.

Organisms in the soil may be classified as saprophytes or parasites. Saprophytes break down dead organic material, while parasites attack living material. Soil organisms may also be grouped as being heterotrophs or autotrophs. Heterotrophs obtain carbon and energy from organic matter. Autotrophs obtain carbon from carbon dioxide and energy from the sun (photoautrotrophs) or from chemical reactions (chemoautotrophs). The indigenous populations are termed autochthonous, while the fluctuating populations are termed zymogenous (Davy, 1969).

Soil inhabiting micro-organisms are the viruses, protobacteria, bacteria, actinomycetes, and fungi. Viruses are all parasitic, and protobacteria are parasitic upon bacteria. There are from 10^8 to 10^9 bacteria per milliliter of soil. Heterotrophic bacteria are sensitive to temperature, organic matter, acidity, inorganic nutrients, soil disturbance, organic carbon, and oxygen. Different types of bacteria thrive in different temperature regimes. Psychrophiles like temperature less than 20°C, mesophiles like temperatures from 25°C to 35°C, and themophiles like temperatures from 45°C to 65°C. Population of bacteria are dependent upon organic matter for survival. A neutral soil reaction (pH-7.0) is considered to be optimum. Sugars and starches are beneficial to growth. Soil disturbance incorporates organic matter into the soil or exposes it to the air where chemical oxidation may consume it. Bacteria populations drop rapidly below the surface soils.

Actinomycetes are autochthonous, and the populations remain higher than bacteria in the subsoil. Streptomycetes are important as they fix nitrogen in root associations on non-leguminous species such as alder and snowbrush.

Fungi are heterotrophic and prefer a neutral soil reaction, but have a broad range in pH tolerance. Fungi require oxygen, while carbon dioxide is an inhibitor. Fungi may be separated into five groups depending upon their food supply. These groups are: sugar fungi, lignin decomposers, copraphic, predaceous, and root inhabiting. The root inhabiting fungi are very important and may be pathogenic or beneficial. Mycorrhiza fungi are very important for satisfactory growth of many species of trees. They make nutrients more available, dissolve primary minerals so plants may uptake them as nutrients, and for practical purposes, enlarge surface areas of roots and protect them from pathogenic invasions.

Algae are photoautotrophs and are more important on bare ground than under heavy vegetation. Algae are self-supporting, and some species fix nitrogen.

Lichens are algae-fungi associations. Lichens may be separated into crustose, foliose, or fruticose depending upon their morphology. Lichens do not compete with higher plants. Lichens are one of the prime organisms that start rock on its way to becoming soil. Higher plants move in after the lichens build up a suitable base for food and anchorage. Some lichens have the blue-green algae as partners and can fix nitrogen.

Protozoa are single-celled animals that live in the soil. They are usually abundant if the soil fertility is low.

Multicelled soil-dwelling animals include:

1. Rotifers, which feed upon plant debris.
2. Roundworms, of which nematodes are an example. Nematodes need moisture to be active. Contrary to popular belief, about half the nema-

todes are saprophytes and are beneficial.

3. Annelid worms. Earthworms fall into this group of animals. They secrete an alkaline solution containing amalase. Earthworms are killed when exposed to ultraviolet light. Earthworms are important in incorporating litter into the soil.
4. Vertebrates that burrow into the soil include pocket gophere, rabbits, marmots, moles, shrews, snakes, lizards, and some birds.
5. Arthropods include insects, many of which live in the soil and feed on plant roots. Callembola, or springtails, fall into this group. They are saprophytic. Other soil dwelling arthropods include the centipeds, millipeds and a variety of arachnids. Arachnids are eight-legged and include the spiders, mites, and ticks. Mites are responsible for the digestion of about 15 percent of the weight of new litter.

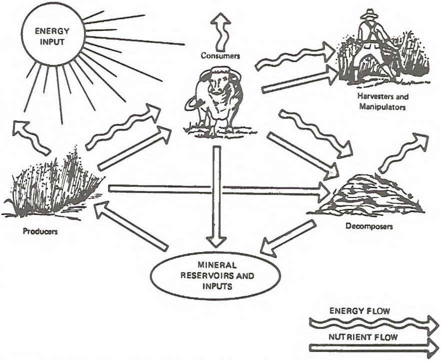


Figure 2-1. A schematic illustration of pathways of flow of energy and matter through a terrestrial ecosystem.

Van Dyne, G. M., 1969. "Some Mathematical Models of Grassland Ecosystems," P. 6, in R. L. Dix and R. G. Beidleman (ed.), "The Grassland Ecosystem: A Preliminary Synthesis." Range Science Department Science Series No. 2, Colorado State University, Fort Collins, Colorado.

Energy Flow. Chlorophyll, the green coloring matter of plants, converts carbon dioxide and water in the presence of sunlight into carbohydrates with oxygen as a byproduct by a process known as photosynthesis. In effect, photosynthesis transforms radiant energy into chemical energy that nourishes the producer plant. During the process, the green plant also incorporates into its protoplasm a variety of inorganic elements and compounds. As the plant is eaten by herbivores, its stored chemical energy (and nutrients) are transferred to the consumers. Likewise, there follows a transfer of energy (and nutrients) from herbivores to carnivores and eventually to the decomposers. Figure 2-1 shows a schematic pathway of energy and matter flow through an ecosystem.

This is a one-way and noncyclic energy flow because, at each transfer along the food chain, energy losses occur. Within each link of the chain, beginning with the producer plant itself, some of the nutrient matter is used to build protoplasm while the stored energy in the remaining food serves as fuel for metabolism and movement. These activities convert the stored energy to heat, which is dissipated into the atmosphere and thus lost from the ecosystem. Thus, energy flows through the ecosystem; it does not cycle. Life is sustained by continually acquiring solar radiation with its influx of new energy (Kormondy, 1969).

Nutrient Cycle. Nutrients produced by green plants via photosynthesis are primarily simple carbohydrates (glucose). Two minor groups of producers, the photosynthetic bacteria and the chemosynthetic bacteria, use methods other than the process used by green plants to create carbon compounds of nutrient value. Further chemical changes, which occur with successive use along the food chain, convert the simple products of synthesis into more complex carbohydrates, proteins, fats, and other nutrients.

These foods continuously circulate throughout the ecosystem from environment to producer, from producer to consumer, from consumer to decomposer, and from decomposer back to the environment, where they are potentially available for recycling. Thus, nutrients remain in the ecosystem; they are not lost as energy is (Kormondy, 1969).

As the decomposers safisfy their own needs for growth and metabolism they concurrently perform an invaluable service to the ecosystem; that is the mineralization of organic matter. By their digestive activity, the decomposers release basic elements such as nitrogen, phosphorus, potassium, and calcium to the environment for reuse by producers. These elements are stored in the soil until extracted by the roots of vegetation, sometimes with the aid of mycorrhizal fungi (consumers) associated with the roots, thus completing the cycle. Elemental nitrogen released from organic compounds by decomposers may be transformed into nitrate (the nitrogren derivative most readily used by green plants) in the soil and stored there or released into the air. Atmospheric nitrogen is continually returning to the nutrient cycle through the action of nitrogen-fixing bacteria, streptomycetes, algae, or natural fixation by lightning.

Hydrologic Cycle. The nutrient cycle is made possible only by the

circulation of water from soil to roots of vegetation, to the atmosphere, and from the atmosphere back to the soil. Soil nutrients must be in an ionic state, in solution, to be absorbed by root systems; this requires the presence of soil moisture (Spurr, 1964). Water also controls the rate of nutrient movement through the conductive tissue of plants, the decomposition of plant litter, and the development of the soil profile which, in turn, affects the availability of nutrients to plant roots as recycling begins. The grassland hydrological cycle is shown in Figure 2-2.

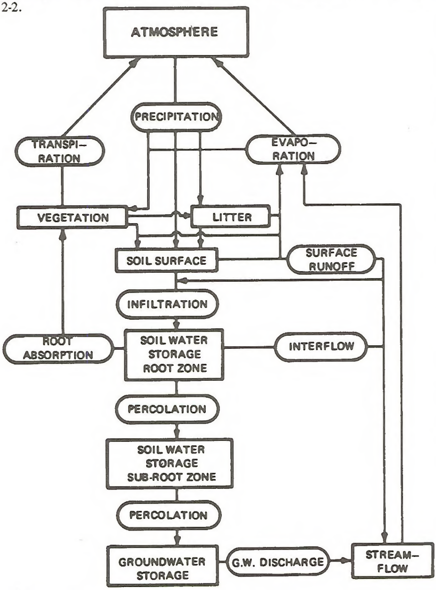


Figure 2-2. Flow diagram of the grassland and hydrologic cycle.

Striffler, W.D., 1969. "The Grassland Hydrologic Cycle," P. 103, in R. L. Dix and R. G. Beidleman (ed.), "The Grassland Ecosystem: A Preliminary Synthesis." Range Science Department Science Series No. 2, Colorado State University, Fort Collins, Colorado.

A major feature of the hydrologic cycle is the interchange of moisture between the earth's surface and the atmosphere by precipitation and evaporation. Significant amounts of water are used by the biota of ecosystems, and there is a substantial return of moisture to the atmosphere by transpiration from living plants, as well as by evaporation. The relative and absolute amounts of precipitation and evaporation significantly influence the structure and function of ecosystems (Kormondy, 1969).

In its broadest sense, the hydrologic cycle involves the oceans, continents, the fresh waters and the Earth's atmosphere. At the level of the ecosystem, the cycling of water includes precipitation from the atmosphere, runoff in the form of stream flow, and a series of intermediate processes influencing the precipitation-runoff relationship. Among these are interception of precipitation by vegetative cover, infiltration and percolation of water through the soil, evapotranspiration from soil and vegetation, surface runoff, and water storage at various levels of the system.

Ground water is an integral part of the hydrological cycle. The ground water reservoir is recharged wherever water, from either direct precipitation or surface runoff, can infiltrate into the land surface and flow downward by gravity. Once in the subsurface, ground water remains in the hydrological cycle by moving through permeable rock to points of ground-water discharge. Ground water can be discharged, to complete the cycle, by many means, such as through springs, to streams, by evaporation where ground water is at or very near the land surface, by transpiration where ground water is at or very near the land surface, by transpiration where ground water is in proximity to root systems, directly to oceans, or mechanically that transmit and yield water in useful quantities.

Ecological Variations. Different ecosystems may vary widely in productivity, one index of which is the amount of vegetation produced over a given period of time. Although biomass (the total weight of the biota, including stored food) is not a consistent measure of productivity, high rates of primary production are often associated with large biomass.

Variations in productivity from ecosystem to ecosystem are due primarily to differences in climate and soil. These factors control energy flow and nutrient cycling, the vital processes by which the ecosystem lives. Generally, productivity is highest in ecosystems where abundant solar energy, ample precipitation, and soils rich in nutrients promote rapid nutrient cycling and growth. The stability of the plant community is related to its productivity. Communities with

low productivity are generally fragile, while highly productive communities generally recover rapidly from the impacts of heavy use or other disturbances (Darling and Milton, 1966).

PACIFIC COAST COAL PROVINCE (Including Alaska)

Of the nationwide total of 530 Federal coal leases, 10 are in this province. Four of these are in Alaska.

Geology

Coal fields in Washington, Oregon, California, and Alaska comprise the Pacific Coast Coal Province.

Coal Areas in Washington, Oregon, and California. The principal coal fields of the states along the Pacific coast lie in the Pacific Mountain physiographic system, which extends through California and the western parts of Oregon and Washington as a series of two major mountain chains and related intermontane basins and troughs (Fenneman, 1931). The system includes two principal physiographic provinces. The Pacific Border province is characterized by a chain of mountains along the coast and a broken line of valleys east of these mountains. The Cascade-Sierra Mountain province to the east, includes the northern and middle Cascade mountains of Washington and Oregon and the southern Cascades and Sierra Nevada in northern California.

The mountains of these provinces consist of metamorphic and sedimentary rocks, granitic intrusive rocks, Tertiary basin fill deposits, and extensive areas of volcanics. The mountains are due in part to igneous intrusions and crustal movement and in part to volcanic accumulation. The topography ranges from rolling hills and flat alluvium-filled valleys to towering volcanoes along the rugged crest of the Cascades.

In California, scattered small deposits of coal are reported throughout the state in 43 counties, but mining or intensive prospecting has been carried on at less than a dozen localities. The coal is mostly Eocene to Miocene in age and ranges in rank from lignite to high-volatile B bituminous. The higher rank coals are largely due to structural deformation and are found in the highly folded and faulted rocks along the Coastal Ranges (Landis, 1966).

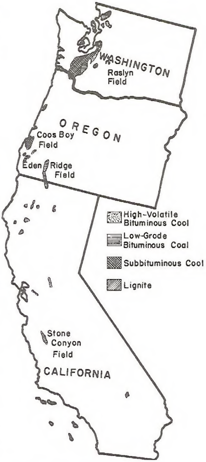


Figure 2-3. Pacific Coast Province.

Oregon also has many small deposits of coal scattered across the southwestern and northern parts of the state. Early mining activity was concentrated in the Eocene Coaledo Formation in the Coos Bay field near the coast, but thin beds, faults, and steep dips made mining difficult. Coal deposits in the state range from subbituminous C at Coos Bay to bituminous rank in the unique deposits in the John Day basin area. In the John Day area, coals ranging as thick as 3 ft are reported enclosed by tuff and interbedded flows of andesite and other igneous material in the Mascall Formation of Miocene age. In southwestern Oregon, coals of the Eocene Umpqua Formation are covered by extensive lava flows (Mason, 1969).

Washington has larger and more extensive coal deposits than does Oregon. The coal deposits range in rank from lignite to anthracite, but most are subbituminous and bituminous. Some are of coking quality. The coal is mostly Eocene in age, but ranges from pre-Tertiary to Miocene. The moderately high ranks of the Eocene coals are largely due to compression during intense structural deformation. High ash contents of some of the coals was caused by volcanic ash falls during accumulation of the coal (Beikman and Gower, 1960).

The principal coal areas lie along the western margin of the Cascade range in a discontinuous belt that extends from the Canadian border south to the Columbia River. However, the major coal-producing area has been the Roslyn field on the east flank of the mountains. In the Roslyn area, several coal beds ranging as thick as 7 ft are mined. The coals increase in value and rank to the west toward the mountains.

In the Centralia-Chehallis district on the west side of the mountains extends over an area of more than 200 square miles. In this area, coal beds are contained in the Upper Eocene Skookumchuck Formation and are of generally lower rank, ranging from lignite to subbituminous B, but are also of greater thickness, ranging as thick as 40 ft.

Most of the coal areas of Washington are characterized by gently to steeply dipping strata, faults, and locally extensive glacial cover that makes prospecting and surface tracing of the coal beds difficult.

Coal Areas in Alaska. In Alaska there are some known coal fields, others only partially explored that are probably underlain by coal-bearing rocks, and numerous reported occurrences scattered throughout the state. Coal occurs in all of the major physiographic areas (Barnes, 1961) but seems to be concentrated in the Interior Plains on the north coast and in the Pacific Mountain System in the southern part.

The principal recognized coal fields or regions in Alaska are Central Alaska, Cook Inlet-Susitna, Alaska Peninsula, and Southeast Alaska regions in the Pacific Mountain System and the Northern Alaska region that lies partly in the Arctic Coastal Plain and partly in the Arctic foothills of

Figure 2-4. Alaskan Coal Areas.

the Rocky Mountain System (Barnes, 1964; Wahrhaftig and Gates, 1964).

The Pacific Mountain System parallels the south coast, curving around the Gulf of Alaska. It consists of two mountainous belts separated by a series of discontinuous depressions. The Pacific Border Ranges province is a northern equivalent of the Pacific Border province that extends along the west coast of the United States. In Alaska, the mountains of the province have been heavily glaciated and the topography, which ranges from 0 to 19,000 ft in altitude, is extremely rugged and is characterized by horns, cirques, aretes, and U-shaped valleys.

The Coastal Trough province separates the two rugged mountain provinces of the system. It consists of the Copper River Lowland and the Cook Inlet-Susitna Lowland, which contains one of the principal coal regions of Alaska.

The Alaska-Aleutian province forms the northern part of the Pacific Mountain System. The province consists of the Coast Mountains, the Alaska Range, the Aleutian Range, and the Aleutian Islands. These mountains resemble the Pacific Border Ranges in most respects because they are glaciated, and rugged, and altitudes range from sea level to higher than 20,000 ft at Mount McKinley.

The Intermontane Plateaus system lies between the Alaska and Brooks Ranges. It is an assemblage of dissected uplands and broad alluvium-floored lowland basins largely drained by the Yukon and Kuskokwin River systems. Several occurrences of coal are reported in this area, which encompasses most of the Central Alaska coal region, but deposits have been mined only for riverboat usage. The active Nenana field, considered geographically a part of this coal region, lies south of Fairbanks in the northern foothills of the Alaska Range.

The great Northern Alaska coal region lies partly in the Arctic Foothills of the Brooks Range (Rocky Mountain System) and partly in the Arctic Coastal Plain, the Alaskan counterpart of the Interior Plains System of the conterminous United States. The Arctic Coastal Plain is a smooth plain rising imperceptibly from the Arctic Ocean to a maximum altitude of 600 ft at its southern margin. The plain is almost without relief except for low hills and is characterized by thousands of lakes and swamps.

The Arctic Foothills province lies above 600 ft altitude and consists of rolling plateaus and low linear mountains rising southward up to the broad northern flanks of the Brooks Range.

Northern Alaska Coal Region (Fields). Upper Cretaceous coal-bearing rocks underlie an estimated 27,000 square miles beneath an area north of the Brooks Range and west of the latitude of the Colville River. These beds have been moderately to gently folded, increasing in intensity to the south toward the mountains. Some 37 bituminous coal beds ranging from 3 to 15 ft thick crop out along the banks of the major rivers in the area. These outcrops suggest that much, if not most, of the entire area is underlain by coal beds. Coal-bearing rocks of Paleozoic age are present along the northwest coast. Though high in rank, they are structurally complex and probably of little economic value.

Central Alaska Coal Regions (Fields). The Central Alaska coal region includes the coal fields of the Intermontane Plateaus System. The coal of this region is mainly of Late Cretaceous and Early Tertiary age with at least one locality reported in the Nation River Formation of Paleozoic age. The coal in the region is reported to range from lignite to bituminous in rank. 9 ft of clean coal occurs on the middle fork of the Koyukuk River and 85 ft of lignite in the Seward district. The localities are mostly small isolated exposures, and though several outcrops might be present in an area, surficial cover or structural complications commonly prelcude tracing particular beds any great distance. The Nenana field is included in the Central Alaska region by Barnes (1964), but physiographically it lies in the Northern foothills province of the Alaska Range. The coal field extends for about 80 miles along the north flank of the mountains ranging from 1 mile to more than 30 miles in width. The subbituminous coal beds are from a few inches to 60 ft in thickness and are contained in Tertiary rocks that have been folded and faulted into a series of basins.

Cook Inlet-Susitna Coal Region (The Susitna-Kenai Coal Fields). Lying within the Coastal Trough physiographic province, the Cook Inlet-Susitna coal region is bounded on the north and west by the Alaska Range and on the south by the Kenai-Chugach mountains. The area includes a long narrow wedge of moderately deformed marine clastic rocks of Late

Mesozoic age and predominantly nonmarine, poorly consolidated Tertiary coal-bearing rocks that overlie older rocks. The coal of the several fields within the region ranges from lignite to bituminous at Susitna and to anthracite in the vicinity of thick sills intruded into the Chicaloon Formation at Matanuska. Thickness ranges from as much as 23 ft for high-volatile bituminous coal at Matanuska to more than 50 ft of lignite in the Susitna field. Most of the region is complicated by folding and faulting in the enclosing beds.

Alaska Peninsula Region. Coal of Cretaceous and Tertiary age is present in the Alaskan Peninsula. The beds are variable in thickness and range in rank from lignite to bituminous. The coal-bearing beds of sand, clay, and gravel are moderately folded and broken by faults. No mining has been attempted in the area for many years.

Southeastern Alaska Region. The Southeastern Alaska region includes a narrow coastal belt along the southeast shore of Alaska and the "panhandle" (southeast Alaska), as well. The coal is mostly Tertiary lignite in the small fields and localities scattered along the coast to the southeast. The rank increases to semi-anthracite and anthracite in the highly deformed crushed and sheared beds of the Lower Tertiary Kushtaka Formation in the Bering River field. The coal occurs in a large number of beds from a few inches to 60 ft thick. Much surface and underground prospecting has been done in the Bering River area. There are inactive coal mines.

Topography

The Pacific Coast Coal Province, including Alaska, is essentially mountainous with wide variations in relief. In Alaska, Mt. McKinley tops 20,000 ft. The Alaskan mountains are the highest and roughest in the country. These include the Brooks, Kuskokwim, and Alaska Ranges. Between these mountains are the Arctic Lowlands and central basin in Alaska. Mountains in the Cascade Range and Sierra Nevadas exceed 14,000 ft in elevation. Between these mountain ranges are the Central Valley in California and the Puget-Willamette Lowlands in Washington and Oregon. The mountains of this area are youthful and may still be uplifting. The mountains trend north-south with frequent isolated volcanic cones.

Climatology

The Pacific Coast Coal Province has the greatest variety of climate in the country. The annual precipitation varies from less than 8 inches in the desert of southern California to over 200 inches in the Olympic Peninsula of Washington. The valleys typically have a lower annual precipitation than the mountains, and the higher amount of precipitation occurs along the coast of northern California, western Oregon and Washington, and the southern coast of Alaska. Some of these coastal areas and coastal mountains may receive more than 5 inches of precipitation within a 24-hour period. Most of the precipitation occurs in November, December, January and February. June, July, August and September are the driest months. However, interior Alaska receives most of its moisture in July, August, and September.

The temperatures along the coast are more moderate than in the interior. The steady flow of the Japanese current across the Pacific Ocean tends to keep the temperatures from changing rapidly. The temperatures in southern California average higher than 50°F in January and more than 90°F in July. In comparison, the temperatures of interior Alaska average 10°F below zero in January and average above 50°F in July. The differences in temperatures are primarily affected by elevation, latitude, and distance from the ocean. The freeze-free days range from more than 300 per year in southern California to less than 30 in northern Alaska. The higher mountains typically have less than 90 freeze-free days per year, while the highly productive agricultural land of California has more than 240 freeze-free days.

Winds along the coast typically come out of the west most of the year. Much of the wind in the fall and winter come out of the southwest in Oregon and Washington. The wind in Alaska is usually from the continent, southwest to the sea, except in the summer when the winds are out of the southwest. The coastal areas are subject to fog much of the year.

Hydrology

The northwestern part of the Pacific Coast Coal Province and parts of Alaska have large supplies of both surface and ground water available. However, not all parts of the region are blessed with an abundance of water. Many large diversion canals and aqueducts transport surface water from areas of high runoff to areas of low runoff. Most of the surface waters in the area have low dissolved solids contents. Sediment concentrations in major streams are generally low except during peak flow periods.

Ground-water yields are high in many areas of the province. The water is generally of good quality, but may be poor in some places.

In the Alaskan part of the Pacific Coast Coal Province, large amounts of good quality surface water are available. However, except for the low-lying areas along the Gulf of Alaska, runoff is highly variable. Except for high sediment yields from many glacier-fed streams, the quality of the water is generally excellent. An exception are the streams that drain extensive marshy and swampy areas. These streams have high contents of iron and organic compounds.

Most ground-water supplies are obtained from river alluvium. Large supplies of ground water can be obtained from alluvium, but the water generally has a high iron content. Ground water in areas overlain by permafrost is usually of poor quality.

Soils

Dominant soils within the Pacific Coast Coal Province are listed in Table 2-1. Some characteristics, uses, and limitations are given for each of the listed soil series. Specific items for each soil such as the unified classification of the subsoils for engineering uses and hyrdologic groups are given as well as general information. Thus, the information may be used by engineers, hydrologists, and soil scientists, as well as the general public to gain some knowledge of the soils. The listed soil series are not inclusive. They occur extensively, but they must be viewed

as examples. A detailed on-site soil survey must be made before all the types of soil are known. More detailed information of soil characteristics and limitations may be obtained from the soil survey reports listed among the selected references.

Vegetation

The coniferous forest of the Pacific Coast Coal Province consists of three, well-defined forest types:

1. The taiga coniferous forest spreads across interior Alaska, narrow fingers follow water courses to the timberline of the Brooks Range.
2. The montane coniferous forest (and alpine communities) covers the Cascade Mountains in Washington and Oregon, the Siskiyou Mountains in Oregon, and the inner Coast Range and Sierra Nevada in Northern California from woodland transition to timberline.
3. The northwest coastal forest, the most dense coniferous forest type, extends along the Pacific Coast from southern Alaska to western Washington, western Oregon, and northwestern California.

Prairies also exist in this province. They are separated into three distinct areas:

1. The Palouse prairie consists of midgrass species. However, extensive areas have been replaced by sagebrush as a result of overgrazing. Large wheat crops are produced in portions of the region.
2. The California prairie originally consisted of midgrasses of the bunch grass type similar in form to those of the Palouse.
3. The Coastal prairie resembles the mixed prairie of the northern temperate grassland. However, the short grasses occur in the coastal prairie primarily because of overgrazing; they are climax dominants in the mixed zone of the northern temperate grassland. Desert shrubs most common are sagebrush, rabbitbrush, and greasewood. Common grasses are wheatgrass and Idaho fescue. Woodland bushlands occur in drier areas adjacent to the forests. Oak is a common species growing in this area.

The coastal forest in western Oregon.

Wildlife

Most animals found in the coal-bearing areas of the Pacific Coast Coal Province are characteristic of either the northwest coastal forest subbiome, the boreal coniferous forest subbiome (tiaga), the broad schlerophyll community, or the tundra biome.

Coastal and Boreal Coniferous Forest Wildlife. In the northwest coastal forest, there is usually a deep layer of duff and an organic soil rich in micro-organisms. Shade from the large trees results in a poorly developed vegetative understory. The Roosevelt elk, black-tailed deer, black bear, and cougar are characteristic larger animals. The mountain beaver, brush rabbit, Douglas chickaree, northwest coast bat, and coast mole are common residents. Birds that might be found in the coal areas include the Pacific horned owl, northern spotted owl (threatened), bald eagle, sooty grouse, red crossbill, hermit warbler and chestnut-backed chickadee.

Many of the small mammals, birds, and amphibians found in coastal forests depend on the variety of insect life that abounds in the damp mild environment, as well as the great mass of seeds produced by evergreen trees. Deer and elk commonly utilize natural or man-made openings in the dense

The taiga coniferous forest in interior Alaska, South of Fairbanks.

Table 2-1
Some Characteristics, Uses, and Limitations of Dominant Soils
Occurring in the Pacific Coast Coal Province

<table>
<tr><th>Soil Name</th><th>Location</th><th>Unified Classification</th><th>Available Water Capacity (inches)</th><th>Hydrologic Group</th><th>Relief (%)</th><th>Vegetation</th><th>Major Use</th></tr>
<tr><td>Hugo</td><td>California (USDA, 1972c)</td><td>SC</td><td>4-8</td><td>B</td><td>0-70</td><td>conifer forests, shrubs, grasses and forbs</td><td>forestry</td></tr>
<tr><td colspan="8">Limitations – Good timber producing soils, well-drained, very gravelly soils, very severe erosion hazard</td></tr>
<tr><td>Clearlake</td><td>California</td><td>CH</td><td>8-10</td><td>D</td><td>0-3</td><td>grasses, shrubs and forbs</td><td>hay, grain & orchards</td></tr>
<tr><td colspan="8">Limitations – Shrink swell potential is high, three to five feet to seasonal watertable surface cracks when dry, runoff is slow until surface is sealed then it is rapid, drainage improves productivity.</td></tr>
<tr><td>Yolo</td><td>California (USDA, 1972c)</td><td>ML, CL</td><td>9-12</td><td>B</td><td>0-3</td><td>annual and perennial crops</td><td>cultivated crops and orchards</td></tr>
<tr><td colspan="8">Limitations – Subject to flooding, well drained.</td></tr>
<tr><td>Orford</td><td>Oregon (USDA, 1970)</td><td>MH</td><td>9-12</td><td>C</td><td>0-65</td><td>conifer forest</td><td>wood crops</td></tr>
<tr><td colspan="8">Limitations – Well-drained uplands, severe erosion hazard.</td></tr>
<tr><td>Active Daneland</td><td>Oregon (USDA, 1970)</td><td>SP-SM</td><td>–</td><td>–</td><td>0-60</td><td>none</td><td>recreation</td></tr>
<tr><td colspan="8">Limitations – Unstable and subject to severe soil blowing, droughty, vegetation is difficult to establish.</td></tr>
<tr><td>Hembre</td><td>Oregon (USDA, 1969)</td><td>ML</td><td>9-12</td><td>B</td><td>0-70</td><td>conifer forest</td><td>wood products</td></tr>
<tr><td colspan="8">Limitations – High erosion hazard in cutbanks, highly productive stable mantles.</td></tr>
<tr><td>Nehalem</td><td>Oregon (USDA, 1969)</td><td>ML or CL</td><td>9-12</td><td>B</td><td>2-8</td><td>grass and legumes</td><td>pasture</td></tr>
<tr><td colspan="8">Limitations – Alluvial bottoms, subject to flooding.</td></tr>
<tr><td>Amity</td><td>Oregon (USDA, 1972b)</td><td>ML or CL</td><td>9-12</td><td>C</td><td>0-8</td><td>annual and perennial grasses</td><td>pasture, grains and seed</td></tr>
<tr><td colspan="8">Limitations – Somewhat poorly drained, low terraces, compaction hazard is severe, watertable restricts use.</td></tr>
<tr><td>Kinney</td><td>Oregon (USDA, 1972b)</td><td>ML</td><td>5-9</td><td>B</td><td>0-70</td><td>conifer forest</td><td>wood products</td></tr>
<tr><td colspan="8">Limitations – Well-drained uplands, unstable on steep slopes, erosion hazard severe on steep slopes, subject to frost heaving.</td></tr>
<tr><td>Cinabar</td><td>Washington (USDA, 1972a)</td><td>ML</td><td>12+</td><td>B</td><td>0-85</td><td>conifer forests, annual & perennial grasses</td><td>hay, pasture & wood products</td></tr>
<tr><td colspan="8">Limitations – Well-drained, terrace, erosion hazard on cutslopes and compacted areas is severe.</td></tr>
<tr><td>Puyallup</td><td>Washington (USDA, 1972a)</td><td>SM</td><td>6-9</td><td>B</td><td>0-3</td><td>row crops, hay pasture and orchards</td><td>farming</td></tr>
<tr><td colspan="8">Limitations – Somewhat excessively drained, subject to flooding, pervious when compacted.</td></tr>
</table>

Table 2-1 (Continued)

Soil Name	Location	Unified Classification	Available Water Capacity (inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Grove	Washington (USDA, 1960)	GP-GM	3-6	A	0-60	conifer forests	wood products, feed crops, homesites
Limitations – Glacial outwash plains, gravelly soils, droughty and low in fertility.							
Coal Creek	Alaska (USDA, 1968)	CL	9-12	D	0-3	sparse birch, white spruce, cedar & willow	wood crops, hay, pasture
Limitations – Poorly drained, silty soil in stream valleys, extremely acid topsoil.							
Fairbanks	Alaska (USDA, 1963)	ML	3-6	B	0-45	spruce, birch, alder	wood products
Limitations – Very susceptible to erosion by water.							

overstory, such as caused by fires or logging, taking advantage of resulting nutritious ground vegetation. Closed canopy forests that provide winter cover and escape shelter are a crucial part of game animal habitat.

Among the less common species are the endangered Columbian white-tailed deer found in parts of Oregon and Washington (Engles, 1965) and the fisher.

Boreal coniferous forest species common in parts of the Alaska coal regions are moose, lynx, wolverine, red squirrel, snowshoe hare, northern flying squirrels, spruce grouse, and crossbills. Most animals use the dense evergreen growth for cover and for protection in winter weather. They can tolerate cold winters with much snow. The herbivores are principally browsers. Some, such as the moose, snowshoe hare, and grouse, depend, at least in part, on broad-leaved plant communities in burns or natural openings.

West Coast and Alaska streams produce the anadromous steelhead and five commercially important species of salmon: the chinook, sockeye, chum, pink, and coho. Migratory populations of coastal cutthroat trout occur in coastal streams from California to Bristol Bay, Alaska. Resident rainbow and cutthroat trout are common in some coastal forest waters along with a variety of warmwater and nongame fishes.

In the Copper River delta of Alaska, important goose and eagle nesting areas and extensive clam beds are found.

Many forms of aquatic and semi-aquatic wildlife inhabit the estuaries and immediate coastal zone where coal occurs. Some of these are:

Rock Ptarmigan.

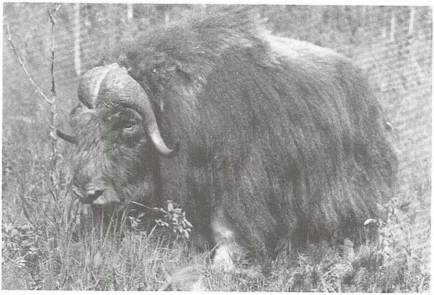
Caribou.

Mammals
Sea otter
Pacific harbor seal
California harbor seal
California sea lion

Birds
Common Loon
Brown pelican
Western gull
Common murre
Black brant
Surf scoter

Fish
Sea or surf perches
Flounders
Greenlings
Ling cod
Rock fishes
Pacific herring
Northern anchovy
Smelt

Wolverine.



Musk Ox.

Many other species of shorebirds and waterfowl use this important coastal habitat as residents or migrants. These species are dependent on clean brackish or salt water and the adjacent beaches or mudflats for their immediate habitat or for the plants or animals that constitute their food supplies. Dungeness crabs are numerous in most bays, and they are eagerly sought as a sport catch. This species also supports an important commercial fishery. The eelgrass plant community is very important to some species of fish, gaper clams, and crustacea.

Broad Schlerophyll Wildlife. The broad schlerophyll community is primarily oak brushland. It contains many important wildlife species which are dependent on the great variety of transition zone hardwood trees and shrubs. Acorns provide food for tree and ground squirrels, certain woodpeckers, and wood ducks, and are readily used by black-tailed deer in the fall and winter. Ceanothus, manzanita, scrub oak, and mountain mahogany are preferred browse species for wintering deer. The Pokegama-Jenny Creek area of the California border provides winter range for the largest migrating black-tailed deer herd in Oregon. Several subspecies of mule deer range throughout the broad schlerophyll community in California and southern Oregon. Typical mammals include the mountain lion, bobcat, coyote, skunk, and brush rabbit. The Merriam chipmumk, California mouse, and five-toed kangaroo rats are confined to chaparral.

Other mammal species include the dusky-footed woodrat, Oregon gray fox, ringtail, and the Pacific pale bat. The valley quail, scrub jay, Sacramento towhee, red-shafted flicker, and the acorn woodpecker are characteristic birds. The sharp-tailed snake, Siskiyou Mountain salamander, and leopard salamander are common species in this community. Freshwater fishes are similar to those mentioned in the previous section as occurring in the coastal forest.

Tundra Wildlife. Even with the low temperatures, short growing seasons, low precipitation, and intermittent freezing and thawing of the thick, spongy mat of low tundra vegetation, many mammals and birds remain in

the tundra biome throughout the year. They include the caribou, musk ox, arctic hare, arctic fox, lemming, and ptarmigan. Other characteristic mammals of the Arctic slope include the polar bear, arctic wolf, wolverine, Alaska red fox, marmot, Perry's ground squirrel, redbacked mouse, and several moles and shrews.

The uplands are inhabited by caribou (except in winter), Dall's sheep, grizzly bear, marmot, ground squirrel, rock ptarmigan, horned lark, and lapland longspur.

Large numbers of birds migrate to the tundra to nest and rear their young during the brief summer. Few birds remain in winter; even the snowy owl may move southward. Willow ptarmigan are usually present year round.

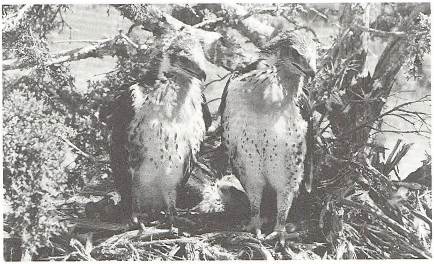
Hoards of insects live in the low elevation of the tundra. Most hibernating insects withstand temperatures down to 50° below zero. Mosquitoes, gnats, flies, beetles, bugs, bumblebees, wasps, moth larvae, spiders, and mites may overwinter in plant tufts and under stones and driftwood.

The tundra lakes, ponds, and bogs do not support large populations of aquatic life because of a lack of minerals and nutrients. Characteristic fish are lake trout, arctic char, grayling, and whitefish. The arctic grayling is abundant and well distributed in tundra waters. The shefish inhabits the major rivers. The chum and pink salmon are anadromous fish that spend part of their life cycle in tundra streams. Sockeye salmon fry migrate from streams to lakes and spend one or two years in the lakes before they migrate to the sea.

Endangered species include the American and Arctic peregrine falcons which breed above the Arctic Circle; the Aleutian Canada Goose, which nests on some of the islands in the Aleutian chain; and the musk ox, which once eliminated in Alaska, has been reintroduced. Other endangered species found in the coal province which may occur on Federal coal lands are found in Appendix C.

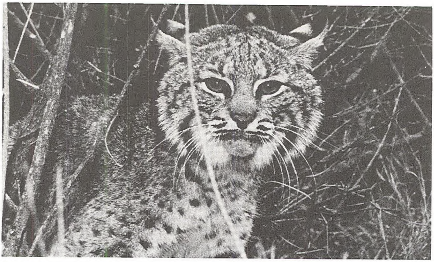
Tundra waters generally are of such purity that any influence of man can be detected in water quality and in changes in aquatic biota. The presence of a relatively large and varied inverte-

Marmot.



Ferruginous rough-legs hawk.

Bald Eagle.



Bobcat.

Great horned Owl.

Sitka black-tailed Deer.

brate fauna of insects, worms, snails, etc., is probable in most parts of the province, but current knowledge and sources of information are inadequate to permit meaningful discussion of them in relation to Federal coal lands.

Land Uses

Primary coal deposits in the Pacific Coast Coal Province are in the States of Alaska and Washington. The North Slope deposit in Alaska is located entirely within tundra and muskeg. Due to the location and character of the area, land uses are limited. Primary use is by wildlife and domestic reindeer. Abundant and varied fish and wildlife populations contribute support to the Alaska tourist industry and are enjoyed by Alaska citizens. Fishing and hunting are particularly important to native Alaskans because wildlife has historically furnished the sole means of survival. Recent times have brought mineral exploration and development activities to the tundra. Extensive northern oil and gas fields are within the coal region.

Southern Alaska coal deposits in the vicinity of Cook Inlet are primarily within the forested area. Major land uses include timber production, outdoor recreation, and use by wildlife. Oil is produced within the coal area on the Kenai Peninsula.

Land uses in the coal area of Washington State include agriculture (cropland and grazing), timber production, and general recreation and wildlife uses. Some deposits are in the vicinity of intensive uses including commercial, residential, and industrial.

Population Patterns and Considerations

This province contains widely divergent population factors. However, Federal coal occurs in rural areas rather than in densely populated areas. Land uses include agriculture and timber production in California, Oregon, and Washington.

The Alaska portion of this province differs greatly from other areas in that the population is very sparse, about 200,000 of which 55,000 are mostly Indians and Eskimos.


Black Bear.

Human Value Resources

Introduction: The following policy and process will only be enumerated one time in this statement. However, it is applicable to all the coal provinces where federal coal occurs.

It is the Department's policy to offer coal leases, under EMARS, only in those areas where the land managing agency's planning process has progressed through one complete cycle. Thus an inventory of the human resources, as well as, consultation with all the known interested public, including state and other federal agencies, will be completed prior to assigning lease offering to a planning unit.

This inventory and evaluation of the human resources values includes, but is not limited to, an assessment of the scenic qualities of the area; natural, unique, and cultural features; potential and existing historical and archeological sites; and social traditions of the area. All known data sources including the state's historic officer, register of historic sites, applicable federal register, state archeologic officer, etc. will be contacted during the planning process.

Esthetic Values Where Coal Occurs

Washington. Small, scattered pockets of Federal coal occur on the western slopes of the Washington Cascades where dense coniferous forests cover rugged land forms. Strong linear contrasting forms with deep, green colors broken on occasion by massive rock outcrops produce a scale that is full of interest and variety.

Oregon and California. Scattered coal deposits are found in the Siskiyou Mountains, southwestern Oregon and in the Klamath – Trinity Mountain area of northern California. Land forms are rugged, often breaking up vegetative types with large exposed rockslide faces. Deep gorges and valleys cut through the area and emphasize the ground scale.

Alaska. The coal leasing lands within this portion of the province are nearly flat; however, small upheavals occasionally occur that are caused by underlying ice wedges.


Mountain Lion.

Very little changes are apparent in either texture or color. A soft pattern of grassy greens envelops the area with only an occasional small drainage crossing the line of vision. In some areas small ponds dot the landscape.

Lines are difficult to distinguish. In the absence of a manmade intrusion, the strongest line is at the horizon.

Without a structure or road to establish scale, it is difficult to grasp the extent of this biome. Some localized scale, as well as interest exists in the grazing herds of caribou and reindeer that freely roam the tundra.

Historic. Evidence of early settlement and use includes trails, roads, structures, and objects related to historic gold activity, logging, and coal mining. Southern Alaskan fields were first worked by Russians in the 1850's, and this area also contains sites related to other early Russian and American exploration and settlement. Other historic sites are related to coal fields along the Pacific Coast.

Western Oregon was a terminus of the famous Oregon Trail. Early seaports for fur traders and shipping dot the coastline.

Geologic. From the geologic human interest viewpoint, the Pacific Coast Coal Province (including Alaska), is the most diverse and interesting area of all. From Pleistocene Lakes, now long dry, in the California Desert to the volcanoes of Alaska, this province is the richest of all in outstanding features. Mountains dominate one's

impression of this area. Glaciated, high-relief mountains, many of which still have active glaciers, and the beaches of the long shoreline, with its marine erosive and geological features are only part of this province's superlative geologic human interest resources.

Current Federal coal leases are not in areas of outstanding human interest. This does not preclude the existence of unique geological or geothermal features in the leased areas, however. Investigation by qualified personnel should be made of the areas before additional leases are issued. Since coal is found mainly in basins, the rough topography militates against the existence of much coal in those areas of human geological interest.

Archeologic. The archeologic diversity of this province is unique and of great and intricate cultural depth. The Old Cordilleran Tradition of the Northwestern United States gave rise to the Great Basin Desert Tradition which ranged from Baja California into Oregon and Idaho. With its coastal counterparts in time, it blends into the riverine and maritime Northwest Coast Cultures all along the coastline into Alaska where the province includes prehistoric Indians of the Interior and ancestral Aleuts and Eskimos on the western coast and into the Arctic.

These early people's descendants who have not moved to the cities live in much the same way as their ancestral predecessors, hunting, gathering, fishing, and occasionally working for day wages when the opportunities arise.

Camping is a growing recreational land use.

ROCKY MOUNTAIN PROVINCE

Of the nationwide total of 530 Federal leases, 361 are located in this province.

Geology

The Rocky Mountain Coal Province contains a greater variety of coal than any other province in the United States. It encompasses parts of all the physiographic provinces comprising the Rocky Mountain system and part of the Colorado Plateau physiographic province and the extreme eastern toe of the Basin and Range physiographic provinces. The Rocky Mountain system is bordered on the east by the Great Plains.

On the west, the mountains give way to high plateaus, and the change in elevation is not so great as it is on the eastern margins. The western margin is also marked by distinct changes in geologic structure and vegetation.

Table 2-2 illustrates how the various coal regions of the Rocky Mountain Coal Provinces (Trumball, 1960), and (Campbell, 1929) are related to the basic physiographic subdivisions of Fenneman (1931).

Northern Rocky Mountain Physiographic Province The Northern Rocky Mountain Physiographic Province is made up of three mountain groups with distinctive structure and topographic form.

The Idaho batholith type, mainly in Idaho north of the Snake River lava plain nearly to Lake Pend Oreille and in southwestern Montana, is a broad mountainous mass almost lacking in lineation developed on the Idaho batholith, the Boulder batholith, and other subsidiary intrusions, and to some extent on rocks of the Precambrian Belt Series.

The Montana type extends from the frontal Lewis Range across northwestern Montana to the Selkirk mountains of Idaho. These mountains exhibit linear form, are separated by north-northwest-trending valleys, and are highly folded, faulted, and thrust

Timber production is a major land use in many areas of the Pacific Coal Province.

Table 2-2
Relationships of Physiographic Provinces and Coal Regions

Physiographic Province	Coal Region	Location
Northern Rocky Mountains	Yellowstone	West Montana
Middle Rocky Mountains	Big Horn Basin	Northwestern Wyoming
	Ham's Fork	Western Wyoming
Wyoming Basin	Green River	Wyoming, Colorado
	Wind River	Wyoming
Colorado Plateau	Uinta	Utah, Colorado
	Southwestern Utah	Utah
	San Juan River	Colorado, New Mexico
Basin and Range		Small fields in central and southern New Mexico

faulted. They are underlain by sedimentary rocks, mostly of the Belt Series, but also in small areas by Paleozoic and Mesozoic.

The third type is found in southwestern Montana south of the Blackfoot River, between the Boulder and Idaho batholiths. The ranges are short and are separated by broad intermontane valleys or basins. The structures are similar to those in the Basin and Range Province and should be included if not separated from it by the Snake River lava plain. Coal deposits are limited to the Yellowstone region and several small isolated fields in southwestern Montana.

Yellowstone Coal Region. The coal fields in the Yellowstone region (Jones and Hunt, 1952; Campbell, 1929) are neither large in area nor great in commercial importance. The coal is of high-volatile A to C bituminous rank and some has been produced for the manufacture of coke. Mining of coking coal was discontinued because of its high ash. The coal occurs in rocks of Upper Cretaceous age probably equivalent to the Eagle Sandsone (Combo, et al., 1949; Averitt, 1963). In general, the coal beds are thin, impure, and commonly greatly disturbed by folding and faulting.

Middle Rocky Mountain Physiographic Province. There is a major difference in geologic character between the Northern Rocky Mountain province with its Idaho-and-Montana-type mountains and the Southern and Middle Rocky Mountain provinces. Mountains in these latter provinces consist for the most part of great anticlines with granitic cores generally flanked by outward dipping sedimentary strata and separated by synclinal sedimentary basins, or "parks." The rocks are similar in both the Middle and Southern Rocky Mountain provinces; however, the structures are more varied in the Middle Rocky Mountain area. The Wyoming Basin province interrupts the continuity of the Southern Rocky Mountain System as a giant sag between the Southern and Middle Mountain Ranges. It consists for the most part of a number of separate sedimentary basins divided by uplifted axes within the Wyoming Basin province.

This Middle Rocky Mountain Physiographic Province contains only the Big Horn Basin and Ham's Fork coal regions plus some isolated fields not defined within any particular region.

Big Horn Basin Coal Region. The Big Horn Basin Region occupies part of a broad structural basin in the western part of north-central Wyoming covering about 4,400 square miles bounded by the Big Horn Mountains on the east, the Owl Creek Mountains on the south, and the Absaroka Range on the west. It is an area of broad dissected plains with some local badlands and folds around the margin.

Coal-bearing rocks include the Mesaverde, Meeteetse, and Lance Formations of Late Cretaceous age and the Fort Union Formation of Paleocene age (Berryhill, Brown, Brown, and Taylor, 1950). These rocks are exposed around the rim of the basin in a belt 3 to 15 miles wide. The coal beds in these formations are generally lenticular and rarely persist at mineable thickness more than 5 miles along the outcrop. Local folds with dips as steep as 50 degrees cause mining problems and result in irregular distribution of coal outcrops. The coal-bearing rocks extend below deep cover in the central part of the basin, but little is known about the thickness and distribution of the coal beds in the subsurface.

Coal from fields in the Big Horn region ranges from lignite to high-volatile C subbituminous in rank. The beds range in thickness from a few inches to more than 8 ft, but, as mentioned above, they are quite lenticular.

The Bridger, Silvertip, and Red Lodge fields are part of a northern extension of the Big Horn Basin into Montana. High-volatile C bituminous coal was mined in the Bridger and Silvertip fields from rocks in the Eagle Sandstone of Late Cretaceous age. The coalsat Red Lodge was mined from the younger Fort Union Formation, but it is of equivalent rank to the coal in the Eagle Sandstone.

The *Ham's Fork Coal Region* is in the extreme western part of Wyoming and includes small parts of Utah and southeastern Idaho. The coal-bearing rocks crop out in long narrow belts extending from the mountainous northern part of the region to the less rugged southern part near the Utah-Wyoming border (Berryhill, et al., 1950).

The area lies in the highly complex Wyoming overthrust belt, a zone of thrust faults and folded rocks that have resulted in the development of a series of parallel mountain ranges and synclinal valleys. One of the faults is reported to have a displacement of more than 20,000 ft along the side of the Salt River range.

The coal-bearing formations exposed in the region are the Bear River, Frontier, and Adaville Formations of Late Cretaceous age and the Evanston Formation of Paleocene age. The Frontier Formation, the main coal-

bearing unit, forms north-trending outcrop bands generally less than 2 miles wide. It is composed of 2,200 to 3,800 ft of clay, shale, and sandstone and numerous coal beds which occur throughout the formation. The Adaville Formation, which lies 3,000 to 6,800 ft above the Frontier, is similar and also contains numerous beds of coal.

The coal beds in the region range in rank between high-volatile A bituminous in the Frontier coals to subbituminous B in the Adaville. Thicknesses greater than 100 ft are reported for coal beds in the Adaville Formation. The higher quality Frontier coals obtain thicknesses as great as 20 ft. The steep dips make mining difficult in most parts of the region. Strip coal resources of about 1 billion tons are reported.

Wyoming Basin Physiographic Province. The Wyoming Basin includes within its borders both the Wind River and Green River coal regions, as well as the Hanna coal field east of the Green River region. The floor of this basin is a plateau with a maximum east-west dimension of about 250 miles and a north-south dimension of nearly the same. Its total area is nearly 40,000 square miles. It is bordered for the most part by abrupt mountain slopes, indented by long spurs and studded by isolated mountains. The altitude of the plateau surface is generally between 6,500 and 7,500 ft. Through an opening between the Big Horn and Laramie Mountains, this basin floor is continuous with the Great Plains. By a similar opening east of the Uinta Mountains, it is continuous with the Colorado Plateau. Because of the semiarid climate of this area, deflation hollows, alkali flats, playas, sand and silt dunes, and badland topography are common.

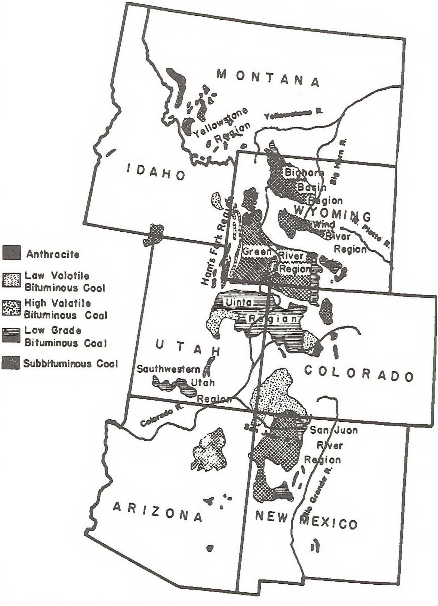


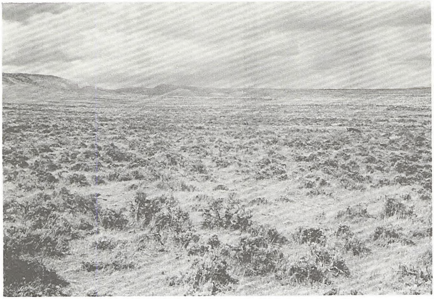
Figure 2-5. Rocky Mountain Province Occurrence of Coal.

The *Wind River Coal Region* occupies the Wind River Basin in central Wyoming (Figure 2-5). The basin is a large northwest-trending asymmetrical syncline that is surrounded by mountain ranges. The Big Horn and Owl Creek Mountains separate it from the Big Horn basin to the north; the Wind River Mountains divide it from the Green River basin to the south and west; and the Casper Arch separates the Wind River and Powder River basins. Around the edges of the basin, narrow ridges are formed by steeply-dipping sedimentary rocks. The dips are less steep toward the center of the basin.

Coal-bearing formations include the Cody Shale, which is 3,050 to 4,480 ft thick; the Mesaverde, 800 to 1,960 ft thick; and the undivided Lewis and Lance Formation, 350 to 3,715 ft thick. The Fort Union Formation also contains coal and ranges from 350 to 4,165 ft thick. Except for the Fort Union, which is of Paleocene age, all of the units are of Late Cretaceous age. They consist of sandstone, sandy shale, shale, and coal. These formations crop out only around the rim of the basin; in the center part, they are unconformably overlain by younger rocks. These rocks also cover some of the coal-bearing units in some parts of the border zone causing discontinuous outcrop patterns.

The coal beds in the region are mostly subbituminous in rank and range from a few inches to a maximum of 17 ft thick and are characterized by steep dips causing difficult mining conditions.

The *Green River Coal Region* lies in the southern part of the Wyoming



The Green River Coal Region in southwestern Wyoming.

Basin physiographic province and encompasses an area of about 17,000 square miles in southwestern Wyoming and northern Colorado. The region is bounded on the north and northeast by the Wind River, Gros Ventre, and Granite Mountains, the Rawlins Hills and the Sierra Madre Mountains on the east, the Wyoming overthrust belt on the west, and the Uinta Mountains on the south. The region includes several separate structural units. The Green River basin occupies the western part separated from the Great Divide basin to the east by the large Rock Springs anticline. The Great Divide basin is further divided into the Washakie basin to the south and the Red Desert basin to the north.

Rocks in the interior parts of the basins are nearly horizontal or dip gently toward the centers, but dips increase sharply around the flanks and around the Rock Springs anticline, where dips range from 5 to 20 degrees.

Coal-bearing rocks include the Mesaverde group and the Lance of Late Cretaceous age, the Fort Union of Paleocene age, and the Wasatch Formation of Eocene age. In Wyoming, at the Rock Springs field, the Mesaverde group consists of the Blair Formation, which is barren of coal; the overlying Rock Springs Formation, the most important coal-bearing unit; the barren Ericson Sandstone; and the Almond Formation, which contains some coal in its lower part. In the Colorado portion of the field, the Iles and Williams Fork Formations contain the Mesaverde Group coal beds. The coal-bearing section of rocks is several thousand feet thick and is composed mainly of sandstone with beds of siltstone, shale, and coal.

The coal beds range in thickness from a few inches to 42 ft and in rank from subbituminous C to high-volatile bituminous C, with coals of higher rank occurring locally in areas of igneous intrusives and intense structural deformation. In past years, the high quality coals of the Mesaverde Group have been the most extensively mined and the most important in the area; but several hundred million tons of strippable Fort Union and Wasatch coal are presently being developed for thermal power generation. The coal beds in most parts of the region lie so deeply buried in the basins that they may never be of economic interest. Several thousand square miles in the region, however, are underlain by coal beds of mineable thickness that can be mined when warranted by demand and economics.

The *Hanna Coal Field* is included here in the discussion of the Green River region although it is not specifically considered a part of the Green River basin area. The Hanna basin is a structurally downwarped area separated from the Green River basin by the Rawlins Hills on the west, and bounded on the north and south by mountains. To the east, it merges with the Laramie basin.

A total of 130 coal beds has been mapped in the coal-bearing Mesaverde and Medicine Bow Formations of Late Cretaceous age, the Ferris Formation of Late Cretaceous and Paleocene age, and the Hanna Formation of Eocene age. The coal beds are subbituminous C to high-volatile bituminous C in rank and range as thick as 8 ft in discontinuous beds in the lower formations and as thick as 35 ft in the Hanna Formation. The Hanna basin area is characterized by rugged surface features and steep dips ranging from 10 to 25 degrees in the areas of outcrop of the thicker coals.

The *Rock Creek Coal Field* adjoins the Hanna Basin field on the southeast and contains coal beds ranging as thick as 9.5 ft in the Hanna Formation and about 8 ft in the Mesaverde. Large areas of the surface are covered with gravel, and the coal-bearing rocks are difficult to trace in the field.

Southern Rocky Mountain Physiographic Province. The Southern Rocky Mountain Province encompasses most of the Rocky Mountains and Sangre de Cristo mountain ranges in Colorado and New Mexico, but includes only the small coal areas of North, Middle, and South Parks, which are parklike intermontane basins in the northern and central Colorado Mountains (Fenneman, 1931). The Southern Rocky Mountain Province consists of broad, deeply dissected north-south strips of mostly granitic crystalline rocks generally flanked by steeply dipping sedimentary rocks that form hogback ridges. The parks are small elliptical structural and sedimentary basins lying between mountain ranges. South Park contains only limited coal resources. Subbituminous coal of Paleocene age was mined in the early days from steeply dipping beds 5 to 17 ft thick on the west side of the basin.

Coal beds in Middle Park reportedly occur only as thin impure beds in the Paleocene Middle Park Formation. More prospecting is needed to adequately evaluate the area.

Southern Rocky Mountain Physiographic Province.

North Park contains several major coal beds of subbituminous B rank in the Paleocene Coalmont Formation (probably equivalent to the Fort Union) (Landis, 1964). These coal beds range as thick as 77 ft (Hornbaker and Holt, 1973) and are contained in about 3,500 ft of coal-bearing strata underlying an area of roughly 850 square miles. Dips in the areas where coal was mined range from less than 10° to 85°, no doubt causing considerable mining difficulties.

Colorado Plateau Physiographic Province. The Colorado Plateau Physiographic Province is a vast roughly circular area covering approximately 130,000 square miles of Arizona, New Mexico, Colorado, and Utah. It includes the Uinta, the San Juan River, and the Southwestern Utah coal regions of the Rocky Mountain Coal Province, as well as several isolated fields and basins.

For the most part, the rocks of this plateau province are horizontal or nearly horizontal sedimentary strata. The landscape is highly dissected and sculptured in many places into canyons, mesas, and buttes, and consists of wide plateaus and uplifts, and broad basin areas. The boundaries of this plateau province are the base of the Rocky Mountains to the north and northeast, a bold escarpment extending southward from the Wasatch Range to the Grand Wash Cliffs at the western margin of the Grand Canyon region at the west and northwest, and, at the southeast and south, the hydrographic boundary, the drainage divide between the Gila and Colorado Rivers, is taken for convenience as the southern limit of this plateau province.

This area in central Colorado is typical of terrain and vegetation in much of the Southern Rocky Mountain Physiographic Province.

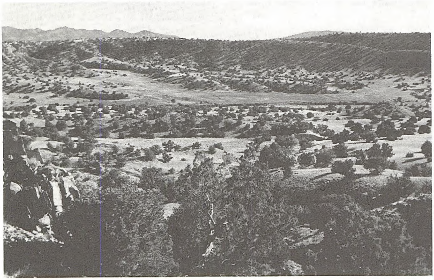
The *Uinta Coal Region* encompasses about 16,500 square miles in parts of east-central Utah and northwestern Colorado and includes both the Uinta and adjoining Piceance structural basins. The region is bounded by the Uinta Mountains on the north, the Wasatch Mountains on the west, the high escarpment of the Book and Roan Cliffs on the south, and the steeply dipping rocks on the flanks of the Rocky Mountain uplift to the east. The region is considered a single structural basin for the sake of simplicity, even though the Piceance basin is separate structurally in a stricter sense. The Uinta Basin is strongly asymmetrical. The rocks on the southern flanks dip gently northward toward the center of the basin with dips rarely exceeding 10° to 15°. The north and northeast flanks are highly complex with major faults, steeply dipping to overturned beds, and multiple successive unconformities which allow youngest Eocene rocks to lie unconformably on Precambrian basement rocks.

Coal-bearing rocks form the south rim of this great basin area, and from this rim they dip towards the middle of the basin and are buried beneath thousands of feet of younger rock.

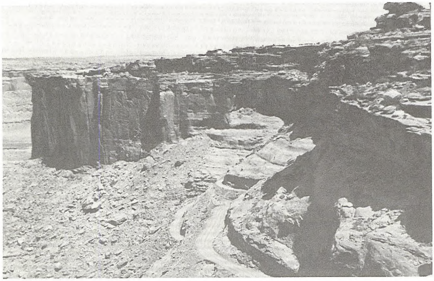
The main coal-bearing rocks in the Uinta region are in the Mesaverde group of Late Cretaceous age (Averitt, 1964). In eastern parts of the basin, these rocks are the William Fork and Iles Formations; in the center part, they are the coal-bearing Black Hawk and Neslen Formation. In the western part of the basin, coal beds 6 in. to 18 ft thick are reported from the lower Mancos Shale. Coal is not generally found in this position in the section, but in fields to the southwest, the

Mancos is the principal coal-bearing unit. Coal beds 2 to 7 ft thick are also reported from the Frontier Sandstone member of the Mancos in the Vernal field in the northwest part of the region. Thin and impure coals are also reported in beds of Mississippian age.

The character of the coal changes throughout the basin, and detailed description of these changes, together with discussions on thickness and occurrence, is not possible in this report. In general, the coal beds range from 5 to 15 ft thick and thicknesses as great as 40 ft have been reported. They range in rank from subbituminous C to coking high-volatile A bituminous throughout most of the basin. The Castlegate and Sunnyside areas of the Book Cliffs field in Utah and the Somerset field in Colorado are large producers of medium to strongly coking bituminous coal. The Coal Basin district of the Carbondale field near Glenwood Springs, Colo. is famous for a particular quality medium-volatile coking coal that is shipped and widely used as a blend with other coals to improve coking quality. In the Crested Butte field in Colorado, some beds have been metamorphosed to anthracite and semianthracite by igneous intrusions.



This area in New Mexico is typical of the terrain and vegetation on the Colorado Plateau Physiographic Province.



Kaiparowits Plateau in Utah, part of the Colorado Physiographic Province.

The coals of the Uinta basin are not as numerous or extensive as those of the Green River basin to the north, but even so, the Uinta region contains an enormous quantity of coal. Because of the depth of cover, strip-mining potential is limited, and probably only a small portion of the total coal will ever be mined.

The *Southwestern Utah Coal Region* has received considerable attention since the building of Glen Canyon Dam and the filling of Lake Powell, especially since plans were made for large-scale thermal power-plants in the area. The region is characterized by high cliffs rising above the flat-lying older sedimentary rocks to the south and by rolling plains dissected by canyons at the top of the section, away from the escarpment.

The region consists of the Kaiparowits Plateau, Alton, and Kolob areas in southwestern Utah. The Kaiparowits Plateau lies in a shallow synclinal basin bordered on the west by a steep monoclinal flexure and to the south by several parallel anticlines and synclines. The Alton and Kaiparowits areas are separated by the Paunsaugunt fault. The Alton and Kolob areas are separated by the Sevier fault, and the Kolob is limited on the west by the Hurricane fault.

The Straight Cliffs Sandstone of Late Cretaceous age is the main coal-bearing unit in the region. It contains four coal beds ranging from 2 to 30 ft in thickness that are persistent throughout the area and several thin, discontinuous beds as well. The coal occurs in a zone 300 to 600 ft above the base of the formation. The coal beds are mostly flat lying to gently dipping and range in rank from subbituminous A to high-volatile C bituminous. The coal is of generally of lower quality than that of the Uinta region, but it is completely adequate for use in thermal powerplants. Underlying the Straight Cliffs, the Tropic Shale and Dakota Sandstone Formations also contain coal beds, but they are commonly thin and not persistent. The coal-bearing zone in the lower part of the Straight Cliffs Sandstone in the Kolob area contains workable coal beds up to 7 ft thick. Mining potential in the region is primarily underground; however, about 200 million tons of

coal are reported strippable in the Alton area.

To the west, in the Harmony field, coal beds have been metamorphosed to semianthracite around an igneous intrusion.

In the Henry Mountains area, coal beds occur in the Upper Cretaceous Ferron and Emery Sandstone members of the Mancos Shale in a shallow structural basin on the west side of the Henry Mountains. The coal is of high-volatile C bituminous rank and ranges from 2 to 7 ft thick. Some of the coal is mineable by strip methods, but the area is quite remote and the long distance to market has discouraged development.

The *San Juan River Coal Region* lies south of the San Juan Mountains, partly in Colorado and partly in New Mexico. It is a great basin-shaped depression encompassing an area of about 11,000 square miles. The strata in the central and southern parts of the region dip gently toward the center of the basin, but on the north and east side, the dips steepen along the flanks of the bordering San Juan and Nacimiento Mountains. On the west side, monoclinal folds tilt the beds up sharply. The coal-bearing rocks crop out as a narrow belt around the margin of the basin, and they dip under the thick cover of younger rocks toward the center. Where the dip is gentle, resistant sandstone beds form low cuestas; in areas of steeper dips, they form sharp hogback ridges. The outcrop of the coal beds parallels these ridges in a linear fashion along the west margin of the basin.

Coal-bearing rocks of the region include the Cretaceous Dakota Sandstone, the Crevasse Canyon, Menafee, Cliff House Sandstone, and Fruitland Formations, all of Late Cretaceous age, and the Nacimiento Formation of Eocene age. The coal beds in the Dakota Sandstone and Nacimiento are thin, lenticular, and discontinuous and not of present commercial interest. The major coal beds of the area are contained in the sandstone and shale beds of the Crevasse Canyon, Menafee, and Fruitland formation (Kottlowski and Beaumont, 1965).

The coal beds occur along the western side of the region in a very complex stratigraphic sequence deposited in marginal marine environments during a time of alternating uplift and subsidence of the basin, thus causing several transgressions and regressions of the marine shore across the area.

The lenticular coal-bearing sandstones and shales of the formations in the Mesaverde Group range from at least 1,800 ft thick in the southwest portion of the basin to only 220 ft in the northeastern part.

About 1,500 ft of barren rocks separate the coal-bearing formations of the Mesaverde from the Fruitland. The Fruitland ranges from 0 to 530 ft in thickness and is similar in composition to the units of the Mesaverde Group. The thickest and most extensive coals occur in the lower part of this formation at or near the contact with the underlying barren, Pictured Cliffs sandstone. As the Fruitland is traced to the southeast, the number and thickness of the coal beds decreases until commercially important beds are no longer present. The Fruitland is stratigraphically equivalent to the Vermejo and Laramie Formations of the Raton Mesa and Denver regions to the east in the Northern Great Plains Coal Province.

The coals of the Fruitland are generally thicker than the Mesaverde coals, but contain more shale partings and are higher in ash content. The Mesaverde coals rarely exceed 10 ft in thickness and are generally less than 5 ft. Thicknesses as great as 38 ft, including partings, have been reported for the coal beds in the Fruitland Formation.

The coals of both units are of subbituminous rank throughout most of the region, but in the northwestern and northeastern parts, the Mesaverde coals are higher in rank, high-volatile A to B bituminous, and some are of coking quality.

The Dakota Sandstone underlies extensive areas in the Colorado portion of the San Juan River region, but the coal beds are rarely thick enough to be mined and are generally discontinuous and dirty. The coals range considerably in rank; generally they are high-volatile C to B bituminous with a high ash content. In the northern tip of the region at the Nucla Naturita field, three beds of Dakota coal 3 to 5 ft thick are mined for use at the Nucla powerplant.

The *Black Mesa Coal Field* lies wholly within the Hopi and Navajo Indian Reservation lands in northeastern Arizona, and is considered here only for completeness. The principal coal-bearing rocks are the 300-ft Toreva and the 750-ft Wepo Formation of the Upper Cretaceous Mesaverde Group. The coal is high-volatile C bituminous in rank and occurs in beds averaging 4 to 6 ft thick and reportedly locally as thick as 14 ft (Averitt and O'Sullivan, 1969). The coal-bearing rocks form the rim and the relatively flat top of Black Mesa.

Basin and Range Physiographic Province. Only a small portion of the Basin and Range physiographic province is included in the Rocky Mountain Coal Province. Topographically, the Basin and Range Province is distinguished by isolated, roughly parallel mountain ranges separated by sediment-filled, nearly level desert basins. The area common to both the coal and physiographic provinces is characterized in the western part as having the typical half-mountain, half-plain topography of the Mexican Highland section. This western part extends east of the Rio Grande Valley until pronounced basin ranges stop alternating with basins.

The eastern part, the area containing a large portion of the isolated coal fields of the southern Rocky Mountain province, forms the Sacramento section, a meeting ground of the three major physiographic systems of this portion of the United States. The Rocky Mountains, Interior Plains, and Intermontane Plateaus systems represented by the Southern Rocky Mountain, Great Plains, and Colorado Plateaus physiographic provinces clearly contribute their characteristic features to the general configuration of the area.

This area contains a number of separate coalfields and isolated outlying coal-bearing rocks too small and commercially unimportant to be considered here separately. Coal in these fields occurs in rocks of the Upper Cretaceous Mesaverde Group in beds as thick as 7 ft. The coal is mostly bituminous in rank, and some areas have produced excellent quality cok-

ing coal as well as anthracite (Read, et al., 1950). Some of the better known fields include the *Cerrillos, Datil Mountain, Carthage, Jornada del Muerto*, and *Sierra Blanca* in New Mexico and the *Pinedale* and *Deer Creek* fields in Arizona. Some of these fields have been developed to some extent because of local proximity to markets or because they contain coal of a particular nature or of better quality than could be obtained from the larger regions. However, the geologic structure of most of the fields is commonly quite complex, and mining problems caused by faulting and igneous intrusions have discouraged large-scale operations.

Topography

The topography of Rocky Mountain Coal Province is the roughest and most mountainous of the United States, except for portions of Alaska. Elevations vary from 4,000 ft to more than 14,000 ft above sea level. The province consists generally of northwesterly trending mountain ranges paralleled by numerous valleys. Exceptions to the general directional trend of the mountains are the San Juan in Colorado and the Uinta Mountains in Utah, which are east-west oriented.

The Continental Divide meanders through New Mexico, Colorado, Wyoming, and Montana, nearly equally dividing the province from east to west. The local relief can vary from a few hundred feet in valleys and high plains over great distances to extremes of over 3,000 ft in less than a mile.

Along with the mountains in the province are several large topographic basins. Several of these are closely associated with coal deposits, such as the Green River, Wind River, and Big Horn Basins in Wyoming. Several small valleys in western Montana have noncommercial coal deposits. The Snake River Valley covers a large portion of southern Idaho, but has no coal. The Uinta Basin of east central Utah is a plateau and swings easterly into west central Colorado and has major coal deposits. The high plateau of southern Utah and Colorado and northern Arizona and New Mexico offer sharply dissected topography, especially along the river canyons.

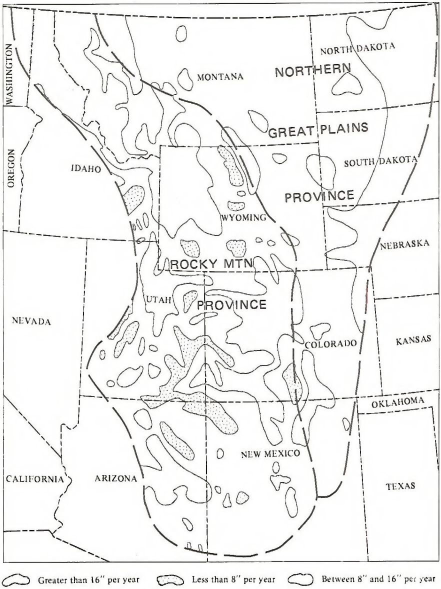


Figure 2-6. Mean annual precipitation.

Adapted from: Geological Survey. The National Atlas of the United States of America, 1970.

The San Juan Basin in New Mexico and the San Luis Basin in Colorado are broad areas surrounded by mountains.

Climatology

The climate of the Rocky Mountain Coal Province is primarily controlled by the elevation and central continental location. The province extends from southern Arizona and New Mexico to the Canadian Border of Idaho and western Montana. The temperatures, rainfall, wind, frequency of storms, amount of snowfall, and other factors making up the climate vary widely.

The mean annual precipitation of the high mountains exceeds 32 in. of precipitation per year. These areas are located in northern Idaho, western Montana, northwestern Wyoming, northeastern Utah, and central Colorado. As the elevation becomes lower, the amount of precipitation drops to 16 in. in the foothills and valleys. More than half of the province receives between 8 and 16 in. of precipitation (Figure 2-6). Several areas receive less than 8 in. per year such as southeastern Idaho, the Big Horn and Green River basins of Wyoming, eastern Utah with fingers sticking into western

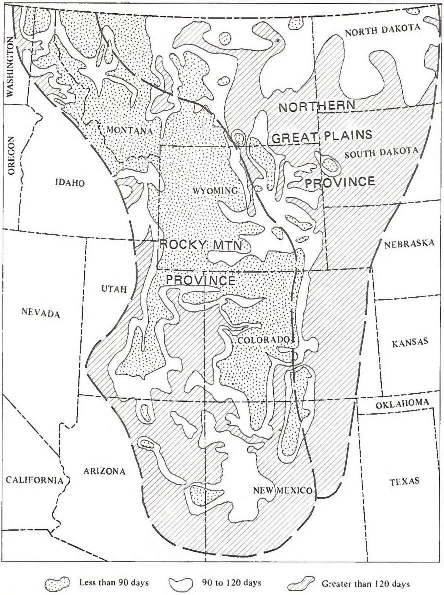


Figure 2-7. Mean annual frost-free days.

Adapted from: Geological Survey. The National Atlas of the United States of America, 1970.

Colorado, northwestern New Mexico, and northern Arizona.

The areas receiving less than 8 in. of precipitation have very sparse vegetation and are classed as semidesert. The areas receiving between 8 and 16 in. per year generally support grasslands, and those areas with more than 16 in. support some trees. The northern area receives a fairly general distribution of precipitation throughout the year, while the southern and westernmost areas tend to have dry summers. Light showers or occasional thunderstorms are common throughout the high mountains in the summer.

Temperatures range from 50° below zero to 115° above (Figure 2-7). The mean monthly temperatures in the north range from 10° above zero in January to 60° in August (Figures 2-8 and 2-9). The mean monthly temperature in the southern part of the province ranges from 40° above zero in January to 80° in August. Prevailing winds for most of the area are generally out of the southwest. Most of the harsh winter storms are out of the northwest. The wind patterns are frequently affected by the mountain structures. Strong violent winds frequently funnel through some of the mountain passes and canyons. Winds out of the southeast coming up from the Gulf of Mexico bring much of the summer moisture along the eastern boundary or front range of the mountains. These moisture winds seldom penetrate very far west of the front range. The wintertime relative humidity of the Rocky Mountain area is around 50 to 70 percent. The summertime relative humidity ranges from 40 to 60 percent. There are local exceptions to these figures. The winter winds out of the north typically bring cold dry air with velocities sometimes exceeding 40 mph.

Hydrology

The major surface water drainage basins in the Rocky Mountain Coal Province include parts of Missouri River, the Colorado River, Columbia River, Arkansas River, and the Rio Grande. The average annual runoff within the province varies from less than 1 in. to over 30 in. in some of the high mountains.

Much of the large streams in the area are perennial, obtaining most of their runoff from the higher mountainous areas. Most of the tributaries originating in the lower area are intermittent. Most of this province is vulnerable to droughts of up to several years.

The total dissolved solids in surface waters in the province range from less than 100 mg/l in the mountains to more than 1,800 mg/l in the basins. The amount of dissolved solids in a watercourse is affected by the type of soil and rock in the region, the length of time the water has been in the watercourse, and the extent to which the flows are affected by other water sources. Although the specific chemical composition is an important consideration in determining whether water can be used for specific purposes, the total amount of dissolved solids in the water generally is the controlling factor as to whether a water supply is chemically suitable for most general uses.

The average suspended-sediment concentrations in streams in the province ranges from less than 200 ppm to more than 30,000 ppm. Suspended-sediment concentrations as high as 700,000 ppm have been measured

during peak flows on some tributaries to the Colorado River. Suspended sediment in streams is comprised of particulates such as sand and silt. The ability of streams to carry suspended sediment increases with stream velocity. Suspended sediment tends to be greater in areas where soil is not held in place by dense vegetative cover.

Groundwater in this province occurs in alluvium and bedrock aquifers. Alluvium in the region generally is a good aquifer and is capable of yielding moderate amounts of groundwater (a few hundred gpm, gallons per minute) to wells and as much as several thousand gpm to wells at a few places. Unlimited pumping from alluvial aquifers is restricted in most states in this province, due to the effects of pumping on prior appropriated water rights on nearby stream flow. The quality of water in the alluvium is generally acceptable for most uses, but in some areas, it is highly mineralized.

The principal and most widespread bedrock aquifers in the province are beds of sandstone and limestones. Yields of most sandstone aquifers are low to moderate, while the highly variable limestone aquifers may yield up to 1,000 gpm to wells. In general, where the aquifers are highly permeable, good quality water is obtained even to depths of 1,000 ft or more. However, where the aquifers have low permeability, highly mineralized water is obtained even at shallow depths. The dissolved solids content of most bedrock aquifers increases from recharge areas in the mountains to the center of the basin. Many large areas in this province, including areas underlain by coal, have no nearby perennial surface water supplies, and the groundwater supplies are limited or of poor quality. Much of the good quality water potential in the province has not been fully explored.

The hydrology of the four coal regions in the province is discussed below.

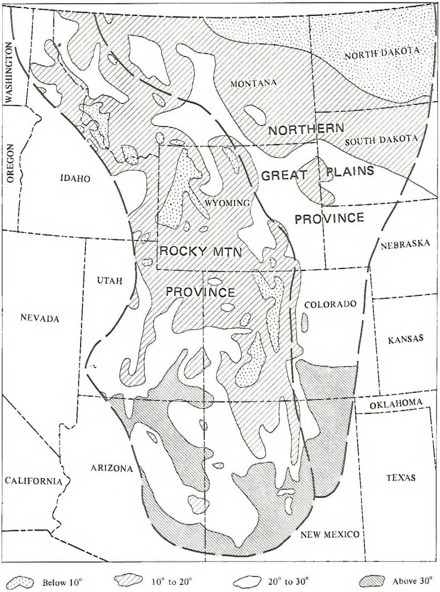


Figure 2-8. Mean January temperature.

Adapted from: Geological Survey. The National Atlas of the United States of America, 1970.

Big Horn Basin Region. The Yellowstone River and its tributaries, the Clark Fork River, and the Big Horn River, are the major perennial streams in the Big Horn Basin region. Most of the smaller streams are intermittent. During high flows, the surface waters generally have a low dissolved solids content, but during the low flows, the water is highly mineralized in part because of the return of irrigation water. The sediment concentration in the streams in the region is generally high.

River alluvium generally supplies the highest yields of good quality groundwater, though the water is of poor quality in some areas.

Groundwater supplies from bedrock aquifers are generally small, and the quality of the water ranges from acceptable to poor.

Uinta Region. The Uinta Region is drained by the Colorado and Green Rivers. Both these rivers are perennial, while most of the tributary drainage in the region is intermittent. The dissolved solids content of most tributary waters is high, especially during low flow, with sodium, sulfate, and chloride the major ions. During high flows, the sediment concentrations on both the major and tributary streams in the area is very high.

Most of the groundwater supplies in the region are obtained from alluvial wells. However, in many areas the alluvium contains poor quality water, especially below irrigated areas. Small supplies of groundwater can be ob-

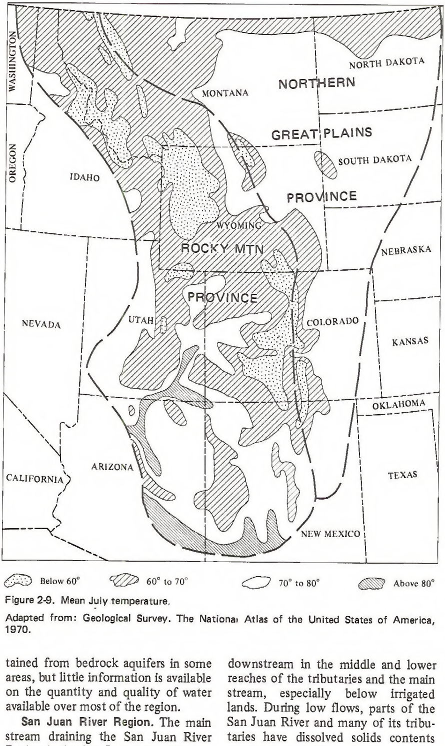


Figure 2-9. Mean July temperature.

Adapted from: Geological Survey. The National Atlas of the United States of America, 1970.

tained from bedrock aquifers in some areas, but little information is available on the quantity and quality of water available over most of the region.

San Juan River Region. The main stream draining the San Juan River Region is the San Juan River. This is a perennial stream that supplies a large proportion of the water resources for the Region. Waters in the headwater streams contain less than 100 mg/l dissolved solids and are a calcium bicarbonate type. The headwater streams generally contain little sediment. The sodium and sulfate content of the water increases progressively downstream in the middle and lower reaches of the tributaries and the main stream, especially below irrigated lands. During low flows, parts of the San Juan River and many of its tributaries have dissolved solids contents greater than 1,000 mg/l. Many of the tributaries in the middle and lower reaches of the basin are intermittent. During high-flow periods, the suspended-sediment content of the San Juan River and many of its tributaries may exceed 50,000 ppm.

Groundwater is obtained from stream alluvium and a few bedrock aquifers. The river alluvium yields moderate to large supplies of groundwater, but in many areas, the water is of poor quality. The bedrock aquifers generally yield small to medium supplies of groundwater, but in the lower parts of the region, the quality of water is often poor. The groundwater potential of the bedrocks aquifers in large areas of this region has not been fully explored.

Green River Region. The main streams draining the Green River Region are the Yampa River and the Green River. Both streams are perennial, but most of their tributaries are intermittent. The quality of surface waters in the area range from good in the higher elevations to poor in the lower elevations. During low-flow periods many tributary streams have over 1,000 mg/l dissolved solids. The major ions in most surface waters of the area are calcium, sodium, sulfate, and chloride. The suspended-sediment content of surface waters is generally high, and during high flows exceeds 30,000 ppm in many tributaries.

The groundwater resources of the area are largely unexplored, but some alluvial wells and bedrock wells are present. Alluvial wells generally yield moderate to large amounts of water, but in many areas, the water is of poor quality. Bedrock aquifers generally yield small amounts of water to wells, and the quality is quite variable.

Soils

Soils within the Rocky Mountain Coal Province are described by coal regions. Tables 2-3 through 2-7 for each region, or for two regions where the soils are similar, lists some dominant soil series which occur in that particular area. Some characteristics, uses, and limitations are given for each of the listed soil series. Specific items for each soil such as the unified classification of the subsoils for engineering uses and hydrologic groups are given as well as general information. Thus, the information may be used by engineers, hydrologists, and soil scientists as well as the general public to gain some knowledge of the soils. The listed soil series are not inclusive. They occur extensively in the region under which they are identified, but they must be viewed as examples. A detailed, on-site soil survey must be made before the

Table 2-3

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Big Horn and Wind River Regions of the Rocky Mountain Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Boyd	Wyoming	CH	4-6	D	0-12	grasses, small grains	rangeland
Limitations – Clayey soil, high shrink-swell, severe compaction hazard, moderate erosion hazard.							
Dunlap	Wyoming	ML-CL	8-10	B	0-18	hay, small grains	pasture, cropland
Limitations – Moderate erosion hazard on gentle slopes, severe erosion hazard on steeper slopes.							
Midway	Wyoming	CH	2-5	D	0-35	grasses, small grains	rangeland, cropland
Limitations – Shallow, clayey soil with high shrink-swell characteristics, calcareous, difficult to manage. Severe water erosion hazard on steeper slopes, compaction hazard.							
Rosebud	Wyoming	SM	6-10	B	0-35	grasses, small grains	rangeland, cropland
Limitations – Moderate to severe water erosion hazard, severe wind erosion hazard.							
Chipeta	Wyoming	CL	1-2	D	3-30	grasses	rangeland
Limitations – Shallow soil, severe erosion hazard, rapid runoff, active gully erosion, clayey soil.							
Arvada	Wyoming	CH	4-8	D	0-6	grasses, small grains	rangeland
Limitations – Saline, clayey soil, high shrink-swell, difficult to manage, severe compaction hazard.							
Cherry	Wyoming	CL	10-14	C	0-25	crops and grasses	cropland, rangeland
Limitations – Slight to moderate erosion hazard, poor road fill material.							
Billings	Wyoming	ML	6-10	C	0-10	irrigated crops, grasses	cropland, rangeland
Limitations – Alkaline soils, well drained, moderate erosion hazard, soils can be managed well.							
Rough-broken	Wyoming		1	D	10-100	sparse grasses	limited rangeland
Limitations – Includes rock outcroppings, steep canyon walls, shallow stony soils on very steep slopes. Soils have a very severe erosion hazard.							

total soil resource is known. More detailed information of the soils characteristics and limitations may be obtained from the soil survey, listed in the selected references.

Descriptions of soil organisms in the Pacific Coast Coal Province also apply to the Rocky Mountain Coal Province and the other coal provinces.

Vegetation

In the Yellowstone Coal Region, small scattered coal fields lie in various biomes, grassland, cold desert, and montane coniferous forest.

Included in the Big Horn Basin Coal Region is an intermixture of the grassland, cold desert, and a somewhat drier portion of the montane coniferous forest (inland Douglas-fir) biomes. A cold desert area is covered with widely scattered saltbrush and greasewood plants indicating salty soils. In this northeastern portion of the basin, where annual precipitation is only 4 in., stunted saltbrush plants grow 18 in. apart. With more precipitation, sagebrush and grasses produce more. On the surrounding mountain slopes, with up to 24 in. of rain and snow, inland Douglas-fir grows.

The Wind River Coal Region includes portions of the cold desert and grassland biomes similar to those in the Big Horn. There is little saltbrush-greasewood, however.

The Green River region is mostly covered by a sagebrush-grass mixture. Included in the Green River region is

Table 2-4

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Green River Region of Rocky Mountain Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Billings	Utah (USDA, 1959)	ML	6-10	C	0-10	irrigated crops, grasses	cropland, rangeland
Limitations – Alkaline soils, well drained, moderate erosion hazard, soils can be managed.							
Chipeta	Utah (USDA, 1959)	CL	1-2	D	3-30	grasses	rangeland
Limitations – Shallow soil, severe erosion hazard, rapid runoff, active gully erosion, clayey soil.							
Fruita	Utah (USDA, 1959)	SM	2-5	B	0-10	blue gramma, sagebrush, cactus	pasture
Limitations – Calcareous materials about 15 in. deep, severe wind erosion hazard.							
Green River	Utah (USDA, 1959)	SM	2-5	B	0-3	cottonwood, greasewood, willows	pasture
Limitations – Poorly drained soils, seasonal water table at about 11 in., very shallow soils, but roots extend into C horizon, subject to flooding.							
Shavano	Utah (USDA, 1959)	SC	3-5	B	2-50	aspen, blue gramma	rangeland
Limitations – Severe erosion hazard, shallow soil, about 15 in. to sandstone bedrock, droughty soil.							
Ravola	Colorado (USDA, 1955)	ML	6-8	B	0-6	grains, saltgrass, wheatgrass	irrigated cropland, rangeland
Limitations – Alkaline and saline soils, severe erosion hazard.							
Badland	–	–	–	–	10-80	juniper grasses	limited rangeland
Limitations – Active eroding, high surface runoff, nearly bare shale hills, very severe erosion hazard.							

more saltbrush-greasewood, indicating salt near the surface. There is also some montane coniferous forest represented by inland Douglas-fir.

At Kemmerer, Wyo., 9 in. of annual precipitation comes mostly as snow (56 in.), and 60 to 80 percent of the snow sublimates (evaporates) without being absorbed into the ground. The moisture left in the area for the usual evaporation, runoff, and use by plants and animals is then less than 4.5 in. every year, (May, 1967).

The Uinta Coal Region has varied vegetative cover ranging from saltbrush-greasewood, indicating much salt in the soil, and sagebrush of the cold desert, through pinon-juniper and mountain mahogany oak of the woodland-brushland biome to coniferous forests including ponderosa pine, inland Douglas-fir, and spruce-fir communities in areas of higher rainfall.

The San Juan River Coal Region includes galleta and grama grass areas of the grassland biome. These grasses do better here because they have adapted to growing during the warm season, July through August, when most of the annual precipitation falls as rain. In the northern temperate grasslands, little galleta is found. Blue grama may form almost pure stands, but it is not so productive under the spring and early summer rainfall pattern as in the southwest where rainfall comes during the late summer. Four-winged saltbush, winterfat and northern needle and thread grass do well in this region. Also, in the San Juan River Region, pinon-juniper of the woodland-bushland biome and ponderosa pine-inland Douglas fir of the drier part of the montane coniferous forest biome.

The southwestern Utah Coal Region is predominantly the dry pinon-juniper of the woodland-bushland biome. Saltbrush and greasewood grow in arid salty areas. A small area of wheatgrass-bluegrass represents the grassland biome. At the highest elevations, Douglas-fir and spruce-fir forests and at somewhat lower elevations ponderosa pine of the montane coniferous forest biome are found.

Table 2-5
Some Characteristics, Uses, and Limitations of Dominant Soils Occurring in the San Juan River Region of the Rocky Mountain Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Menefee	Utah (USDA, 1962)	CL	2-4	D	2-40	pinon-juniper grasses	rangeland
Limitations – Shallow soil, some areas are cobbly. Mancos shale is within 20 in. of the surface, severe erosion hazard. Management alternatives are limited by depth and slope.							
Monticello	Utah (USDA, 1962)	ML	7-10	B	2-10	wheat, beans, pinon-juniper grasses	cropland, rangeland
Limitations – Wind erosion hazard is severe, management opportunities are good, fertility and organic matter content is good.							
Montvale	Utah (USDA, 1962)	ML-CL	1-2	D	2-25	pinon-juniper sagebrush, grasses	rangeland
Limitations – Soil is less than 20 in. deep, stony throughout, severe erosion hazard, low fertility.							
Northdale	Utah (USDA, 1962)	ML	5-7	C	2-10	wheat, beans, pinon-juniper, grass	cropland, rangeland
Limitations – Severe erosion hazard, high fertility, permeability is moderate.							
Sandstone-Rockland	Utah (USDA, 1962)	–	–	D	2-100	sparse juniper, bluegrass	limited grazing
Limitations – Outcroppings of Dakota sandstone, fragile sites occur within the canyons.							
Berent	New Mexico (USDA, 1968)	SM	3-5	A	0-25	grasses	rangeland
Limitations – Severe wind erosion hazard, many areas severely eroded by water.							
Las Lucas	New Mexico (USDA, 1968)	CL	6-8	C	0-25	grasses	rangeland
Limitations – Severe erosion hazard, high fertility, gullies present.							
Penistaja	New Mexico (USDA, 1968)	SM	4-6	B	0-5	grass, sagebrush	rangeland
Limitations – Moderate water erosion hazard, severe wind erosion hazard. Management practices need to be on the contour; some slickspot areas.							
Jekley	New Mexico	CL	2-6	C	3-40	ponderosa pine, grass	forest
Limitations – Moderate to severe erosion hazard, shallow soils, cold soil temperatures, high fertility.							
Kiln	New Mexico (USDA, 1967)	ML-CL	.5-2	D	3-40	ponderosa pine grass, oak	forest
Limitations – Moderate to severe erosion hazard, very shallow soil (10 in. to limestone), noncalcareous.							

Wildlife

When describing the wildlife as part of the environment over a broad area, it is desirable to describe the animals in relation to the biotic communities to which they belong. This makes it possible to see, generally, where certain animals species, life forms, types, etc., fit into the environment concerned and how certain actions affecting one element of a community might affect other elements.

Animals found in the various coal regions of the Rocky Mountain Coal

Table 2-6
Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Southwestern Utah Region of the Rocky Mountain Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Badland	Utah (USDA, 1970)				10-80	grasses, juniper	limited range
Limitations – Active eroding, nearly bare shale hills, much surface runoff, very severe erosion hazard.							
Billings	Utah (USDA, 1970)	ML	6-10	C	0-10	irrigated crops and grasses	cropland, rangeland
Limitations – Alkaline soils, well drained, moderate erosion hazard, soils are manageable.							
Chineta	Utah (USDA, 1970)	CL	1-2	D	3-30	grasses	rangeland
Limitations – Shallow soil, severe erosion hazard, rapid runoff, active gullies, very susceptible to raindrop splash erosion, clayey soil.							
Kenilworth	Utah (USDA, 1970)	SM	3-5	B	0-20	juniper, pinon	rangeland
Limitations – Shallow, droughty soils, calcareous, severe hazard for reseeding, moderate erosion hazard, deer winter range, stony soil.							
Persayo	Utah (USDA, 1970)	CL	1-3	D	1-20	galletagrass, shadscale	rangeland
Limitations – Shale bedrock at 12 in., inclusion of saline soils, erosion hazard is severe, active rill and gully erosion.							
Beryl	Utah (USDA, 1960)	SM	1-3	B	0-1	small grains, potatoes, grasses	rangeland
Limitations – Shallow to calcareous layer, severe wind erosion hazard, associated with Duneland. Contains gypsum so soil will respond to irrigation management.							
Dixie	Utah (USDA, 1960)	ML-CL	3-6	C	0-5	sagebrush, galletagrass	rangeland
Limitations – Caliche layer 20 to 40 in. deep, moderate erosion hazard. Some areas have stony surfaces.							
Escalante	Utah (USDA, 1960)	ML	6-9	B	0-1	sagebrush, grasses small grains, potatoes	rangeland, cropland
Limitations – Severe wind erosion hazard, sand and gravel occur below 40 in., low fertility and low organic matter.							
Neola	Utah (USDA, 1960)	ML	1-3	D	0-7	yellowbrush, Indian ricegrass	rangeland
Limitations – Shallow, well drained soils, cemented caliche layer, severe wind erosion hazard, low fertility and organic matter.							
Uvada	Utah (USDA, 1960)	CH or CL	1-3	D	0-2	greasewood, shadscale	rangeland
Limitations – Slickspot soils, clayey textured, difficult to manage, high sodium content.							

Province, are, in general, characteristic of the montane coniferous forest and forest edge and the cold desert portion of the desert biome. The woodland-bushland biome or community occurs principally as an ecotone between the cold desert and coniferous forest biomes throughout the coal province. Although there are some distinctive animals, the woodland community is an ecotone with respect to animal species composition also (Kendeigh, 1961). The coal-bearing formations lie in the intermountain basins and along the flanks of the mountain ranges

Table 2-7
Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Uinta Region of the Rocky Mountain Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Billings	Colorado (USDA, 1955)	ML	6-10	C	0-10	sugar beets, corn, grain, greasewood, shadscale	irrigated crops, rangeland
Limitations – Alkaline and saline soils, moderate erosion hazard, many areas dissected by streams, can be managed.							
Ravola	Colorado (USDA, 1955)	ML	6-8	B	0-6	crops, saltgrass, wheatgrass	irrigated crops, rangeland
Limitations – Alkaline and saline soils, severe erosion hazard, weak structure.							
Badland & Rough Broken	Colorado (USDA, 1967)	–	–	–	5-40	grasses, juniper	limited range
Limitations – Very severe erosion hazard, severely gullied, shale outcroppings, much surface runoff, rock outcrops.							
Chipeta	Colorado (USDA, 1967)	CL	1-2	D	2-10	sparse cover of grasses	rangeland
Limitations – Shallow soils, fine textured, severe erosion hazard, active gully erosion, large amount of overland flow.							
Mesa	Colorado (USDA, 1967)	SM	4-6	B	0-10	grasses	rangeland, tilled crops
Limitations – Substratum contains gravels, moderate erosion hazard.							
Ashly	Utah (USDA, 1959)	SM or GM	1-2	A	0-5	rabbit brush, cottonwood, willows	rangeland, pasture
Limitations – Seasonal high water table, very shallow soil, about 15 in. to gravel layer, subject to overflow.							
Fruita	Utah (USDA, 1959)	SM	2-5	B	0-10	blue gramma, sage cactus	pasture
Limitations – Calcareous materials about 15 in. deep, severe wind erosion hazard.							
Green River	Utah (USDA, 1959)	SM	2-5	B	0-3	cottonwood, greasewood, willows	pasture
Limitations – Poorly drained soils, seasonal water table at about 11 in., very shallow soils but C horizons contain roots, subject to flooding.							
Shavano	Utah (USDA, 1959)	SC	3-5	B	2-50	aspen, blue gramma	rangeland
Limitations – Severe erosion hazard, shallow soil, about 15 in. to sandstone bedrock, droughty soil.							

which were formed after deposition of the coal. Basins or groups of basins make up the different coal regions. In general, cold desert communities lie on the lower elevation basin floors, woodland-bushland communities are found on the lower slopes and intermediate plateaus and the coniferous forest communities are present on the higher plateaus and along the mountain flanks. The woodland-bushland communities are greatly diminished in the Green River Region and regions to the north while sagebrush-grassland communities are diminished in regions to the south. There is considerable variation in animal species composition north to south even though some species are common throughout the province. Aquatic habitats are somewhat limited in the coal regions of this province, but are highly important to various wildlife species in the generally arid environment.

Terrestial Wildlife. Throughout the montane coniferous forest areas

animal life is characterized by marked seasonal cycles. Invertebrates and many vertebrates are dormant during the coldest months, large numbers of migrating birds arrive in the spring and leave in the fall. Some of the larger species such as deer and elk migrate to the lower elevations during winter. Others, such as the blue grouse and snowshoe hare, remain active having adapted to walking on the snow and burrowing into it for protection. The northern flying squirrel and red squirrel harvest and store food for winter use. Pocket gophers and mountain phenacomys are active under the snow. Predators such as the goshawk, marten, and mountain weasel stalk the forest yearlong.

Some boreal coniferous animals are found overlying the montane coniferous forest species in the province's northern coal regions. The Shiras moose is found in the conifer-aspen type and along the willow bottoms of the riparian woodlands primarily in the Green River and Ham's Fork Coal Regions. Canada lynx occur in forest areas of these same regions. Some species are considered characteristic of both the montane and boreal coniferous forests. These include the snowshoe rabbit, red squirrel, porcupine, deer mouse, water shrew, black bear, ruffed grouse, goshawk, great horned owl, and others.

The woodland-bushland communities, i.e., juniper, pinon-juniper, mountain mahogany-oak, attract species from the adjacent montane coniferous forest. Since the trees are sometimes scattered and interspersed with grass or shrubs, grassland or desert species may penetrate into the community. The mule deer, mountain lion, and coyote commonly occur in the woodlands during the fall, winter, and spring, although most of these species spend summers in the higher mountains. The bobcat, rock squirrel, cliff chipmunks, desert and bushy-tailed woodrats, and pinon mouse show preference for rough country, rocky hillsides, and cliffs within the woodland-bushland communities. Birds such as the pinon jay, band-tailed pigeon, and scrub jay are characteristic. Invertebrate populations are low and consist largely of spiders, ants, termites, and jumping plant lice (Kendeigh, 1961). Rattlesnakes, lizards, and horned toads invade from the desert, but are not particularly characteristic.

A portion of the cold desert in Wyoming showing heavy production of sagebrush and grasses.

The cold desert communities of the Green River, Big Horn Basin and Wind River Coal Regions are largely sagebrush-grasslands. Saltbrush-greasewood associations are present in most regions, but become more prominent in the Uinta Coal Region. The pronghorn antelope and the sage grouse are abundant only in the sagebrush-grass ranges of the province (Sundstrom, 1973, Scott, 1971). This is not surprising since both species are highly dependent upon the sagebrushes for food and cover, especially during the winter. Using figures presented by Sundstrom, as much as 20 percent of the world's pronghorn populations may be found in the Green River Coal Region. A major portion of the world's sage grouse population is also found in the Green River Region. The low, stock form and the arrangement in clumps with intervening open ground make sagebrush favored living quarters for many kinds of animals. It provides shelter from wind, pursuing predators, and the sun in addition to food and nesting sites (Shelford, 1963). The white-tailed jack rabbit, mountain cottontail, desert cottontail, Ord's kangaroo rat, northern grasshopper

Typical Big Horn Coal Region vegetation.

mouse, sagebrush vole, and various pocket mice are characteristic small mammals of the province's cold desert communities. The black-tailed jack rabbit becomes more common than the white-tailed jack rabbit in the southern part of the province. The sage thrasher, sage sparrow, Brewer's sparrow, and ferruginous hawk are characteristic birds. Lizards are most numerous in the southern coal regions, especially in the San Juan Region. The sagebrush lizard is found throughout the province. Invertebrates are most numerous in the sagebrush and greasewood communities and least abundant in the shadscale (Kendeigh, 1961). Spiders, ants, and tenebrionid beetles are the most conspicuous ground invertebrates. Harvester ants build conspicuous mounds throughout the sagebrush communities.

The abandoned McLearn Mine in the Uinta coal region in Garfield County, Colorado.

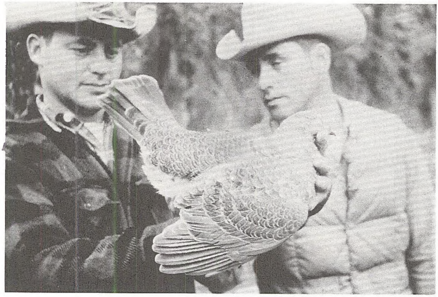
San Juan Coal Region near Farmington, New Mexico.

Some of the species of higher public interest and/or value are wide ranging, often utilizing most types of plant communities found in this coal province. The mule deer are found in all the coal regions. Numbers are usually restricted by the limitations of winter range. Because of these constraints, deer populations are actually controlled by certain areas of range that comprise only small percentages of the total land area. These critical areas must support not only the present deer herds, but also the herds which will be needed to maintain most of the big game hunting for future generations. Deer winter range typically comprises the lower slopes of the mountains and adjoining valley fringes between the deep snow at higher elevations and the edge of farm and ranchlands in the valley. Migration of up to 50 miles and more between summer and winter ranges takes place annually in some areas. The vegetative types that characterize this winter habitat are the pinon-juniper and mountain mahogany-oak at higher elevations and sagebrush type at lower elevations. Deer herds in the northern part of the Green River Coal Region commonly winter almost entirely on sagebrush winter ranges. The White River and Piceance Creek drainages in the Uinta Coal Region supports one of the largest and most productive mule deer herds in the United States.

Elk also occupy extensive areas and are found in all coal regions of the province, but are most prominent in the eastern portion of the Uinta Coal Region, the northern portion of the San Juan River Region, the northern portion of the Green River Region, and the eastern portion of the Big Horn Basin Coal Region. Like mule deer, they are restricted by the limitations of available winter habitat. Typically, elk winter in the conifer-aspen forests and in the woodland-bushland communities of this coal province, but in some areas, notably in the Green River Region, elk winter in the sagebrush-grasslands. In these situations, they are sensitive to human activity. A notable example of elk inhabiting the cold desert community is found in Wyoming's Sands elk herd. As many as several hundred elk live year-round in a remote sand dune-sagebrush-saltbrush habitat far from the nearest trees and mountains. This herd is in the Green River Coal Region.

Two subspecies of bighorn sheep occur in this coal province. Those found in the Green River region and the northern part of the San Juan region are Rocky Mountain bighorns while those found in the Southwestern

Throughout the Montana coniferous forest, animal life, such as these Wyoming Elk, migrates on marked seasonal cycles.



Blue Grouse.

Utah region are desert bighorn (Scott, 1971). The Rocky Mountain bighorn is an animal of the coniferous forest alpine openings, while the desert bighorn occurs in the cold desert community in this province. Turkeys have been reintroduced to much former native range especially in the Southwestern Utah and San Juan Regions. They inhabit the coniferous forest and broken woodland areas. Ring-necked pheasants, some bob-white quail, and chukar partridge have been successfully introduced in the Bighorn Basin Region. Pheasants occur to some extent in most agricultural areas. Chukars have been established in most coal regions.

The exotic Barbary sheep was introduced at one site within the San Juan Coal Region, but reportedly has not done well (New Mexico Department of Game and Fish, 1967).

Conspicuous terrestrial animals found within the Rocky Mountain Coal Province are summarized by biotic communities.

In coniferous forest and forest-edge communities these animals include the water shrew, the snowshoe rabbit, the red squirrel, northern flying squirrel, the deer mouse, the porcupine, the black bear, the wapiti (elk), the mule deer, the bobcat, the mountain lion, the canada lynx, the shiras moose, the wolverine, the marten, the least chipmunk, the yellow-bellied marmot, the golden-mantled ground squirrel, and the bushy-tailed wood rat. Birds include the goshawk, the pigeon hawk, the golden eagle, the great horned owl, the saw-whet owl, the pygmy owl, the flamulated owl, the ruffed grouse, the blue grouse, the yellow-bellied sapsucker, the hairy woodpecker, Williamson's sapsucker, the white-headed woodpecker, the gray jay, the red-breasted nuthatch, Steller's jay, Clark's nutcracker, the common raven, the mountain chickadee, the mountain bluebird, the varied thrush, the western tanager, Cassin's finch, the gray-headed junco, and Audubon's warbler.

In woodland-bushland communities, typical animals include the rock squirrel, the cliff chipmunk, the desert woodrat, the band-tailed pigeon, the acorn woodpecker, Lewis woodpecker, the pinon mouse, the bobcat, and the bushy-tailed woodrat. Birds include the ringtail, the ash-throated flycatcher, the gray flycatcher, the scrub jay, the pinon jay, the plain titmouse, the common bushtit, the blue-gray gnatcatcher, the western bluebird, and the black-throated gray warbler. In cold desert communities, typical animals are the black-tailed jack rabbit, the white-tailed jack rabbit (in the north), the desert cottontail, Nuttall's cottontail, the desert woodrat, the least chipmunk, the Great Basin pocket mouse, Ordi's kangaroo rat, the northern grasshopper mouse, the sagebrush vole, the pronghorn antelope, the coyote, the kit fox, the western spotted skunk, the desert bighorn sheep, the leopard lizard, the sagebrush lizard, the side-blotched lizard, the short-horned lizard, the bullsnake, the plateau whiptail, the racer, and the western rattlesnake. Birds include the red-tailed hawk, Gambel's quail, the sage grouse, the mourning dove, the great-horned owl, the loggerhead shrike, the black-throated sparrow, the sage thrasher, the sage sparrow, and Brewer's sparrow.

Invertebrates constitute the most numerous and diverse of the macro-

scopic animals in the coal provinces. They are poorly known and only now beginning to receive attention commensurate with their taxonomic dominance and ecological importance. Preliminary surveys of the phylum Mollusca, for example, have revealed numerous species which have not previously been looked upon as endangered. In the Rocky Mountain Province there are currently 24 species of land snails which may be considered endangered or threatened with endangerment but which are not yet listed in the Department of the Interior's List of Endangered Native Fish and Wildlife.

As described here, aquatic wildlife includes invertebrates, fishes, birds, mammals, reptiles, and amphibians associated with the stream, lake, and pond-marsh biotic communities.

Aquatic wildlife habitat in the Rocky Mountain Coal Province, as a single geographic entity, historically included a wide representation of the three freshwater biotic communities. However, when considered in terms of the actual geographic location of the individual coal regions within the province and in view of man's alteration of natural surface hydrologic patterns, streams and manmade lakes are the major aquatic habitats to be considered.

Much potential coal country is also home for the Moose.

Pronghorn Antelope.

Streams range from clear, cold rivulets and brooks cascading down the mountain slopes to broad silt-laden rivers flowing through narrow valleys or deep canyons. There is very little warm water in the province. In the southern regions, at lower elevations, either cold water or warm water aquatic species may be found. The principal habitats in a stream are falls, riffles, or rapids, sand-bottom pools, and mud-bottom pools. Mud-bottom pools form in backwaters and behind dams and are essentially young stages of ponds. Typical stream animals are found in the riffles and sand-bottom pools. The most characteristic and abundant stream animals are caddisfly larvae, mayfly naiads, stonefly naiads, fly larvae, crayfish, snails, freshwater clams, and fish.

Streams of the Yellowstone, Big Horn Basin and Wind River Coal regions support fish species typical of the colder headwaters of the Missouri River drainage. Characteristic fish species include the mountain whitefish, Yellowstone cutthroat trout, lake chub, flathead chub, longnose dace, plains minnow, silvery minnow, fathead minnow, white sucker, longnose sucker, mountain sucker, burbot, and sauger. Common introduced species include rainbow trout, brown trout, brook trout, and carp, (Baxter and Simon, 1970; Brown, 1971).

The Green River, Uinta, Southwestern Utah, and San Juan River Coal regions are primarily within the Colorado River drainage. The cutthroat trout and the mountain whitefish are the only native game fishes of the upper Colorado River drainage. These natives have been supplemented, and in the case of the native Colorado River cutthroat, largely replaced by numerous introduced species. Rainbow trout are the most numerous newcomers and are stocked in tremendous numbers each year (Scott, 1971). Other game fish that have been introduced are brown trout, Yellowstone cutthroat trout, brook trout, and arctic grayling in the coldest waters and channel catfish, black bullhead and

yellow perch in the warmer waters. Characteristic nongame fishes are the carp, Utah club, roundtail, bonytail, humpback chub, leatherside chub, redside shiner, Colorado squawfish, speckled dace, fathead minnow, flannelmouth sucker, mountain sucker, bluehead sucker, humpback sucker, and the mottled sculpin (Baxter and Simon, 1970; Scott, 1971; Sigler and Miller, 1963).

Amphibians such as tiger salamanders, the Great Basin spadefoot toad, the boreal western toad, chorus frogs, and leopard frogs are found along streams in all the coal regions of the province. Others such as the western spadefoot toad, Woodhouses' toads, the red-spotted toad and the bullfrog are found only in some of the southern regions (Stebbins, 1966).

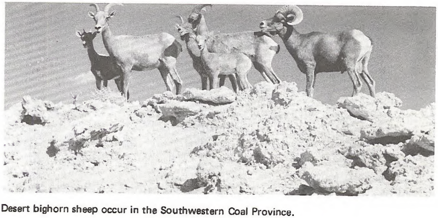
A variety of mammals and birds are closely associated with and at least partially dependent upon stream communities. Bald eagles, kingfishers, and great blue herons harvest fish. Water ouzels dive for aquatic insects. Muskrats, beavers, mink, raccoons, water shrews, river otters, and others are links in the food chains of the streams ecosystem.

The Rocky Mountain Coal Province lacks extensive wetlands so waterfowl numbers are comparatively small. The available habitat consists largely of streams and stream bottomlands, canals, reservoirs, and seeps created by irrigation practices. Food supplies are limited, except in areas of agricultural development. Waterfowl tend to concentrate in areas of irrigation development such as in portions of the Green River and Yampa River valleys in the Green River Coal Region and in the San Juan River valley in the San Juan River Coal Region. Waterfowl are present in greatest concentrations during irrigation. In the summer only the breeding species are found dispersed over the nesting areas. Nesting occurs at waters associated with agricultural lands, river side channels and oxbows, beaver ponds, and to a lesser extent, reservoirs and natural lakes. The Great Basin Canada goose, mallards, pintails, teal, and Barrow's goldeneye are typical nesting species.

There are relatively few natural lakes remaining in the coal regions of this province. The majority of those once in existence have been modified for storage of irrigation water. The acreage of manmade reservoirs far exceeds that of natural lakes. Manmade lakes are usually less productive than natural lakes, but creation of large impoundments such as Yellowtail Reservoir, Boysen Reservoir, Flaming Gorge Reservoir, Lake Powell, and Navajo Reservoir, coupled with fish-stocking programs, has greatly expanded the fisheries of the province. Various combinations of trouts and introduced warm water fish species such as the walleyed pike, large-mouthed bass, small-mouthed bass, black crappie and others may be found in these waters. Lakes provide immense resting areas for migrating waterfowl.

Pond-marsh biotic communities are quite limited in extent in this coal province, but are significant locally. Stock ponds and the river side-channels, oxbows and irrigation seeps mentioned above often support typical pond-marsh animal associations, but probably the most widespread example of this biotic community throughout the province is the beaver pond. Beaver ponds are found in thousands of small streams throughout the province. Their margins are usually marshy and they support rooted vege-

One of the largest and most productive herds of mule deer is found in Colorado's Uinta coal region.



Desert bighorn sheep occur in the Southwestern Coal Province.

tation around the edges. A variety of frogs, toads, snakes, and air-breathing aquatic insects occur here. Sandpipers, killdeer, and snipe search the pond edges, while in the evenings, swallows and bats take insects emerging from the water. Mallards, teal, and Barrow's goldeneye commonly nest around beaver ponds. Typical fish inhabitants are brook, rainbow and cutthroat trout, sculpins, and suckers. The beaver is the most conspicuous aquatic mammal found here. Muskrat and mink are often present, as are raccoon and sometimes otter.

Threatened Species. Those wildlife species determined by the Secretary of the Interior to be threatened with extinction and named on a list published in the Federal Register are officially "endangered species." The species categorized as "threatened" in the Bureau of Sport Fisheries and Wildlife's 1973 publication, *Threatened Wildlife of the United States*, include all vertebrate species whose existence is considered threatened whether they are officially listed as "endangered" or not.

In the Rocky Mountain Coal Province, one mammal, two birds, and three species of fish are presently on the official endangered species list. The black-gooted ferret has been reported on the basis of several observations within the province, but these have not been confirmed. Ferrets are closely associated with prairie dog towns as prairie dogs are their major food source.

One bird considred endangered is the American peregrine falcon. This bird has been extirpated as a breeding species in the eastern United States and is generally decreasing in the West. In the Upper Colorado River area the peregrine falcon is uncommon. Very few nesting peregrine falcons, probably less than a half-dozen pairs, are known to occur in this province. Nests are usually found in coniferous forests or along major rivers. Extreme care should be taken to prevent disturbing them. The southern bald eagle, also endangered, probably occurs in the San Juan River coal region as a winter resident or migrant.

Two of the endangered fish, the humpback chub and the Colorado squawfish, are native to the Colorado River drainage. Both are adapted to a swift water environment. Present indications are that reservoir construction is an inhibiting factor. The natural habitat is obliterated in the impoundment areas, while reproductive requirements are affected by lowered temperature in the tailwater areas. Both are quite rare in the natural stream segments remaining.

A recent addition to the endangered list is the Kendall warm springs dace, which is found only in a warm spring-fed tributary to the Green River in the Bridger National Forest in Wyoming. It is within the Green River Coal Region.

In addition to the endangered species, there are several other species considered threatened within the province.

The spotted bat is evidently America's rarest mammal. It ranges from Mexico and the southwestern states as far north as Yellowstone County, Mont. Until recently, it was thought to be limited to ponderosa and pinon pine habitat. However, it is now known to be a permanent resident of treeless canyonlands in west Texas. The bat has been recorded from the Bryce Canyon area and may occur in a favorable habitat in any part of the province.

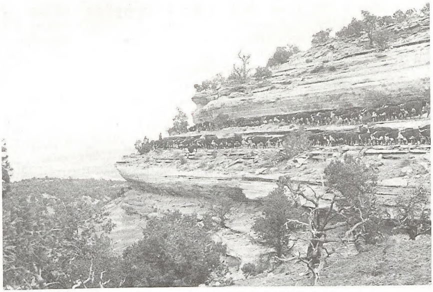
The threatened Utah prairie dog is found in parts of the Southwestern Utah coal region. Most of its range is in the Great Basin of Utah, but a number of colonies located near the Wayne and Piute Counties boundary are in this coal region.

The spotted owl occurs in the San Juan River coal region and possibly in the southeastern part of the Uinta region. This extremely sedentary bird is threatened by removal of old growth timber and disturbance of limited areas of mountain canyon habitat.

Another of the falcons found in this province is considered threatened. This is the prairie falcon, a bird of the canyons, deserts, and open country. It has disappeared from many localities within its overall range in recent years and will appear on the endangered list if this trend is not halted.

The arctic grayling, native of the Missouri River drainage, has been introduced into a number of lakes and the Green River in the Green River coal region. Grayling naturally prefer clear, cold streams with gravelly bottoms and deep holes.

Not officially included, but a candidate for the endangered list is the Colorado River cutthroat. This native of the headwater streams of the Colorado River continues to exist as a pure or relatively pure form in a few remaining areas. Isolated cutthroat populations have been recently found in remnant numbers in remote tribu-



Grazing is one of the most extensive land uses in the Rocky Mountain Coal Province.

tary reaches within Colorado, Utah, and Wyoming. The most extensive populations found to date occur in short stretches of several small creeks in the Green River coal region. In some localities, these populations are threatened by habitat deterioration resulting from watershed erosion. Hybridization with rainbow trout and other types of cutthroat trout is eliminating the subspecies. Management efforts are being directed toward watershed improvement and continuance of barriers that isolate the local populations. This species is presently categorized as "status undetermined."

Some species, while not endangered throughout their range, have remnant populations in danger of being eliminated in local areas. This has prompted state development of "rare and endangered" species lists. As an example, Wyoming's list of rare or endangered species that occur in this coal province include species such as the shovelnose sturgeon and sturgeon chub of the Big Horn River drainage and the Colorado River cutthroat and leatherside chub of the Green River drainage. Others are the osprey, midget faded rattlesnake, Green Basin smooth green snake, wolverine and river otter.

Land Uses

The Rocky Mountain Coal Province features some of the most rugged topography in the United States. For this reason, the major portion of the province today is covered by natural vegetation. The most extensive land use of the area is for grazing by livestock and wildlife. Timber production is of significance and outdoor recreation is an extensive use that is rapidly gaining economic significance, surpassed only by grazing. Data from comprehensive river basin studies on the Colorado River (Table 2-8) provide an idea of the relative significance of the various land uses. The upper Colorado Region is somewhat representative of the Rocky Mountain Coal Province. It includes grazing on 84 percent of the area, cropland cultivation on 3 percent, timber production on 13 percent, urban, transportation, and utilities on 1 percent, outdoor recreation on 65 percent, and formally designated wilderness on 2 percent.

Table 2-8
Land Use Data for the Colorado River Basin, 1965

Land Use	Upper Colorado Region[1] (1,000 Acres)	(%)	Little Colorado Subregion[2] (1,000 Acres)	(%)
Grazing	60,442	84	16,604	96
Cropland	2,225	3	44	–
Irrigated	(1,622)	(2)	(28)	–
Dry Farm	(603)	(1)	(16)	–
Timber Production	9,419	13	1,419	1
Urban & Transportation	929	1	82	–
Designated Wilderness	1,414	2	0	–
Outdoor Recreation	47,543	65	15,128	88
Military	114	–	21	–
Exclusive Fish & Wildlife	229	–	16	–
Intensive Mineral Production	37	–	7	–
Total Land Area	72,234		17,252	

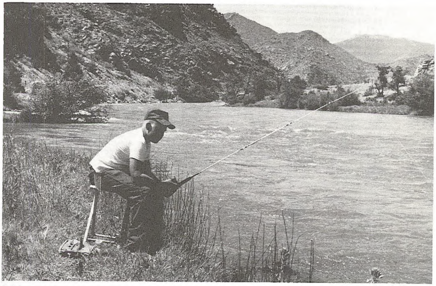
[1]Defined as the Colorado River Drainage and all tributaries above Lees Ferry, Arizona.
[2]Little Colorado Drainage above confluence with Colorado.

Note: Land use acreages are not inclusive and demonstrate some multiple uses.
Source: Comprehensive Framework River Basin Studies, Appendix IX, Land Resources and Use, Upper and Lower Colorado Regions.

The manner in which land uses were calculated demonstrates multiple use.

Agricultural. Grazing of sheep and cattle and cultivated crop production are the most common land uses in the Rocky Mountain Coal Province. It is estimated that 85 to 90 percent of the area is used for agricultural production. This area is also used for wildlife habitat, extensive outdoor recreation, and mineral production.

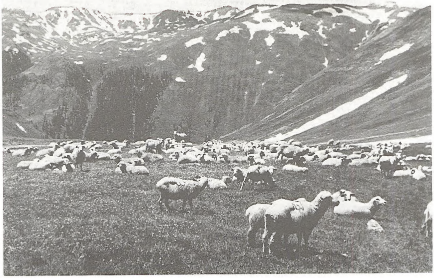
Range lands vary considerably in productivity, but on an average, it takes 10 acres of native vegetation to feed one cow for one month (Data from Upper Colorado Region). The range livestock industry is oriented to production of feeder livestock from



Fishing in clear mountain streams and lakes continues to be a major outdoor recreation land use.

cow-calf and ewe-lamb type operations. A major portion of the grazing lands are in Federal ownership administered by the BLM and the Forest Service.

Croplands are scattered throughout the province, but make up a small percent of land use. It is estimated that 3 percent is cropland, with the majority being irrigated. Some dry land farming takes place under favorable soil and moisture conditions. Livestock feeds are the major crops. This enables producers to balance operations with the available range forage and adverse weather conditions. Major crops include hay, (alfalfa and native), improved pasture, and feed grains. Other crops include food grains, orchard fruits, sugar beets, potatoes, dry beans, and various truck crops.



Ewe-lamb operations are major agricultural land use in the Province.

Timber Production. Coniferous forest occurs in the Rocky Mountain Coal Province primarily between elevations of 5,000 to 11,000 ft. Pinon-juniper woodland is the most extensive forest type but is of minor importance for wood production except for fuel wood. The important timber species include ponderosa pine, Douglas-fir, white fir, lodgepole pine, Englemann spruce, and limber pine. Based on river basin study data, it is estimated that 10 percent of the province is valuable for timber production. The majority of the area is under Forest Service administration with some ownership by States, private individuals, and other Federal agencies.

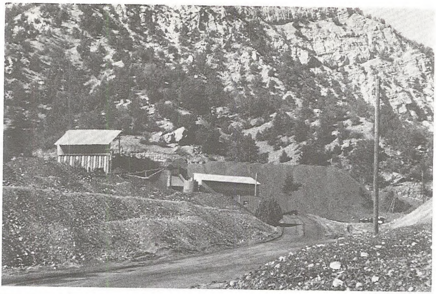
The forest lands are valuable for other uses including watershed protection, wildlife habitat, outdoor recreation, and domestic livestock grazing.

Watershed. The Rocky Mountain Coal Province is headwaters for the major river systems in the west and midwest. Much of the high mountain area produces runoff in excess of 10 in. annually. The quantity and quality of the water is highly dependent upon watershed conditions. Data from the upper Colorado comprehensive river basin study indicates that 40 percent of that area is affected by accelerated erosion. Erosion over the entire province is estimated to be something less than this amount.

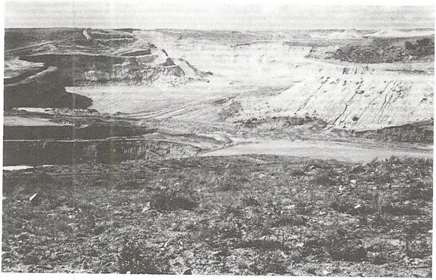
Agricultural-related needs are presently the most significant uses of surface water. In the upper Colorado Region, water depletion by use in 1965 was broken down into the categories of irrigation, 62 percent; municipal and industrial use, 1 percent; minerals and parks, 1.6 percent; recreation and wildlife, 0.4 percent; and livestock water, 1 percent. The rest of the water depletion is due to evapo-transpiration including much evaporation from storage facilities. Surface water use in the province is comparable to the above data, although depletion for power production is known to have accelerated considerably since 1965.

Mineral Industry. At present, mineral production uses only a small percent of the land surface within the province. Using the upper Colorado Region as an example, mineral use was less than 1/10 of 1 percent in 1965. Use, however, is intensive in many cases with significant impact on other uses and on the environment. Some mining activities of the past have left

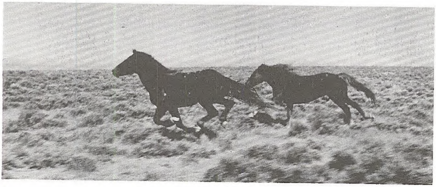
Rocky Mountain Coal Province is headwaters for the major river systems in the west and midwest.



Coal mining is one of the significant land uses in the Rocky Mountain Coal Province. This is the Koal Kreek mine near Cedar City, Utah.



A uranium mine in the Upper Colorado Coal Region.



The Rocky Mountain Coal Province includes extensive areas used by wild horses.

abandoned loading facilities, waste dumps, tailings, ponds, and extensive road systems.

Many minerals are produced, with the following being of significance: Coal, oil, gas, uranium, iron ore, copper, silver, gold, lead, zinc, molybdenum, potash, trona, and phosphates. Mining and primary processing is a major employer in many areas, contributing significantly to local economies. This province also includes the major oil shale deposits in the United States and vast reserves of bituminous sandstone.

Urban and Transportation Uses. Urban uses including residential, commercial, and industrial use along with all types of transportation systems (highways, roads, railroads, airports, power lines, communication lines, pipelines) utilize relatively extensive areas. In the upper Colorado Region, which has no major urbanized areas, this use amounted to more than 1 percent. The Rocky Mountain Coal Province with major urbanized areas along the eastern mountain front in Colorado, the Wasatch front in Utah, and the Albuquerque area in New Mexico make more extensive use of land. It is estimated that 2 percent of the province is used for these purposes.

Higher uses such as these preclude mineral development in most cases. It is possible however that under certain economic conditions, improvements can be removed and replaced to obtain valuable mineral reserves.

Wild Horse and Burro Habitat. The Rocky Mountain Coal Province includes extensive areas used by wild horses. Some of the more significant areas include the Red Desert and Big Horn Basin in Wyoming, the Book Cliff, Piceance Basin, and Douglas Mountain areas in Colorado, Book Cliffs in Utah, and Pryor Mountains in Montana. The Pryor Mountain wild horse range (32,000 acres) is the only formally designated wild horse area within the province. Overall, wild horses utilize extensive acreages and involve many areas that have coal resources. Coal resources are found in the Big Horn Basin, Red Desert, Book Cliff, Piceance Creek, and Yampa River areas.

Wild burros are not a big factor in the province. Some isolated areas have small burro populations.

Mountain Subdivisions. The many factors that make the Rocky Mountain area so inviting to the recreationist and tourist have created mountain recreational and rural residential community developments. Subdividing is taking on major proportions in some locales, particularly in Colorado. Patented mining claims and homesteaded lands are main categories being subdivided. These are intermingled with Federal lands administered by the Forest Service and BLM.

In the Colorado mountain valleys, over 380 rural subdivisions involving 285,000 acres are located adjacent to Federal lands. Coal lands within the San Juan River and southwestern Uinta Coal Regions are specifically affected by these developments. Under mining patents and the homestead laws, coal is reserved to the United States.

Recreational and Educational. Relatively low population, remoteness, and breathtaking scenery combine to make opportunities almost unlimited for the nature lover.

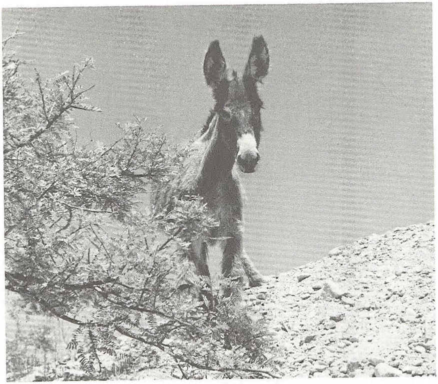
Some outstanding national forests, national parks, and national reserve lands are located in this province, the most famous being Yellowstone National Park. Others such as Bruce and Zion National Parks and the Grand Canyon add to the recreational appeal.

Camping and picnicing facilities are provided by numerous Federal– and state-operated installations.

The Rocky Mountain Coal Province contains considerable historical sites. A history rich in mining activities has left reminders of the past in old installations and ghost towns. Numerous forts have been restored as have pioneer sites and old camps.

Some of the best hunting and fishing in the country is available. Drainages support several varieties of trout, while hunting opportunities include deer, elk, moose, sheep, goats, bear, and pronghorn antelope.

Other activities available to the recreationist include winter sports, rock hounding, horseback riding, and boating.



Burros, too, are found, but are not a big factor in the province.

Population Patterns and Considerations

Social. The Rocky Mountain area is characterized socially by its primarily rural patterns in which political, social, and economic views are generally conservative, with a markedly slower rate of social change than in urbanized areas. Rural localities are notable for their lower rate of acceptance of new social norms and modes.

Sparse distribution of population can be related to the topography and climate of the province. High elevation and sharp relief of the land limits settlement to lower, flatter areas near reliable water supplies.

Technology has changed this pattern only in small part from the days of earliest pioneer settlement, and many of the social values are rooted in the pioneer experience. Related to these environmental extremes of cli-

Camping and picnicking areas are found throughout the Province.

mate, topography, and pioneer ethic are predominant social attitudes of self-reliance and personal independence exhibited by the residents. Traditionally, American pioneer social values and mores are understood as a basically rural heritage, well illustrated in this province. Their attachment to the land, ties of family unity, and community solidarity are, in social viewpoint, keystones of their image. These same strengths are primary contributions to their insularity and apparent reluctance to change.

Political. Salt Lake City, Utah and Denver, Colo. (though the latter is geographically in another coal province) are the political, economic, and social centers for the Rocky Mountain Province and often exhibit polar extremes in sociopolitical orientation. Conservative political views are generally held in the province, expressing a rural thought pattern usually opposed to the liberalism of urbanized areas. Salt Lake City, though urban, is more conservative than Denver or Cheyenne, Wyo., perhaps due to the socially and political conservatism of the influencial Mormon community.

Denver owes much of its political outlook to the great numbers of immigrants from eastern urban centers. This largest city of the province also attracts many of its residents from the smaller neighboring towns and even neighbor states. Conversely, the city, through political and economic considerations, diffuses its influence throughout the state to the effect that people of Colorado are more liberal in political expression and thought than Utah, Wyoming, and New Mexico.

Economic. Economic patterns of the Rocky Mountain Coal Province are closely related to the social attitudes. In keeping with the rural orientation, livestock raising is a major influence, with agriculture usually an adjunct to the livestock industry. Exceptions occur along watercourses, where cropland agriculture is a primary industry, but only on a localized basis.

Mining has been important to all the states in this province with copper, gold, lead, zinc, and silver mining usually capturing the public's attention. Coal has been mined historically in all the province states, but only recently have these reserves received national interest.

Other minerals have local economic prominence. Iron, uranium, limestone, and gypsum are extracted in most of the subject states, but the economic and political base has remained in the predominantly rural orbit in most province states.

Similarly, forest products industries are important, but have not gained dominant positions in the economies except in Idaho. Oil and gas interests have large impacts on the states' economic outlooks. Some states have extensive reserves of petroleum and exploit them heavily while other states in the province have little, but actively seek exploration for this resource.

Of ascendant economic value is recreation and tourism. The Rocky Mountains have long been a mecca for skiers, hunters, and summer visitors from less mountainous states and more densely populated regions of the nation. Yellowstone, the world's first National Park, and many other National Parks, Monuments, and National Forests are located in the Rocky Mountain Coal Province. The Federal Government is expanding its public recreation potential and facilities in this area, as are the states and counties. Some developed recreation units are underlain by coal deposits.

Recreational use is of growing economic importance, due to increased leisure coupled with a heightened awareness of the human need for open space. All the states in this province are presently advertising their recreational values, and this use is showing significant economic growth in all of them.

Major industrialization of this province has not occurred as a concomitant of population growth. Industrial expansion, other than in services to extractive industries, has been limited to the larger population centers. The largest ones have attracted such service industires more than have the smaller cities. The expansion of major population areas as distribution, transportation, and communications centers has been simultaneous with the growth of light industry in these metropolitan areas.

The growth of population in some areas of this province is usually indicated by the expansion of government services. As county populations and tax bases grow, more demands for protection, health, and community services are experienced. Coupled with the growth and shift of emphasis in State governments has been the expansion of Federal agencies to serve the citizens. There has been a trend in the past decade to decentralize Federal administration from the nation's capital to regional centers closer to the people. This has influenced regional economies due to the presence of Federal payrolls. The need for more schools, libraries, churches, hospitals, and highways, water, and sewage districts is measured by the expansion of the urban centers. Smaller cities' growth has awakened many local governments to the need for land use planning and zoning.

All sectors of enterprise are showing growth in the Rocky Mountain Coal Province. Though specific localities may show a net loss of great consequence to themselves, the province as a whole shows growth in population, goods and services, and in annual production.

Ethnic. Ethnic considerations within this province center mainly around its numerous scattered Indian population. Another large minority group is the Mexican-American population, which presently is in a state of rapid acculturation and urbanization within the Caucasian community. Initially, at least, this group should be considered as any other unit of our society within this province. Existing, discernable ethnic minority groups are factors to be considered in environmental analyses before coal development.

Enclaves of other nationalities and ethnic or racial groups are very small or conspicuously absent in the province since they have completed the acculturation process and presently comprise part of the dominant culture.

The native American Indian groups in the province occupy extensive scattered land areas. Many of these possess coal deposits of merchantable quality and disposition. Some, such as the Navajo and Hopi tribes, have begun a program of coal leasing within their reservation boundaries and other tribal lands have been explored for coal

resources. While this statement does not treat these Indian coal lands, it must be understood that coal-leasing actions on Federal lands surrounding or adjacent to Indian properties affect their lives as such actions also affect non-Indians.

Cultural and Religious. The Church of Jesus Christ of Latter Day Saints (Mormon) and its adherents in the state of Utah and to a lesser extent in the surrounding states is an important influence of cultural and religious significance. As a group, Mormon church members generally are conservative in political, social, moral, and business considerations. Within the state of Utah, Mormons are the single most influential religious and social force.

To the Indian of this province as well as other provinces, the natural state of his environment is basic to his cultural identity.

Elements of cultural significance occur within the province in significant array. Uncounted archeological sites, significant paleontological deposits, such as those near Kemmerer and Medicine Bow, Wyo., and many historic buildings, areas, sites, and trails of significance to the nations' history are found. The Oregon Trail, Mormon Trail, Overland Trail, Bozeman Trail, forts of the Indian wars, and routes of early explorations are a few examples of cultural resources found within the province. Some of them are presently under Federal jurisdiction, and others, under state, county, or local authority. Many places eligible for nomination to the National Register of Historic Places exist on and adjacent to coal bearing lands.

Some of the best hunting in the country is available in the Rocky Mountain Coal Province.

Human-Value Resources

Esthetic Values. The Rocky Mountain Coal Province is primarily within the segment of the Rocky Mountain range of the western United States. Extremely rugged landforms prevail, many reaching above 14,000 ft. Interesting and colorful rock formations provide many structural uplifts and basins. The rugged beauty of the mountains was the incentive for the designation of numerous national parks, monuments, and recreation lands in these areas. The great coniferous forests that blanket the slopes are cut by major drainage patterns that feed the Great Plains to the east and deserts to the west.

Lines are dominant in this province. Strong erosion and slide patterns, textural changes between rock and vegetative types, deep valleys cut by major drainages, and irregular skylines contribute to a variety of linear categories.

Altitude and latitude both contribute significantly to color composition, since generally speaking, timberline rises in the southern Rockies. In higher altitudes the herbs and grasses are contrasted with great expanses of bare rock. On the lower slopes vegetative types predominate as major timber stands provide a canopy of green occasionally broken by rock outcrops or slides. Several major lakes, deep and intensely blue, fill intervening basins within the province.

Textural contrasts are extensive. In some areas great rock faces protrude from timbered slopes. Grassy meadows give way to towering stands of timber. Shimmering lakes and rushing streams are significant in the textural element.

All landscape elements are massive.

Historic. Historic sites, structures, and objects are tangible aspects of rich historic resources. They are physical links with the past and landmarks of the American experience. Their preservation and use are vital to comprehension of America's past and how that past has shaped the present and can influence the future. Most of the better known historic sites are included in the national park system or are on or eligible for listing in the National Register of Historic Places. Many other historic sites and structures are administered by state and local agencies. Many of these historical resources are situated on or adjacent to Federally administered coal deposits.

This coal province includes hundreds of historic sites, trails, districts, and structures on and adjacent to Federal lands that are of national, state, and local significance and are related to:

- Early exploration by Spanish, French, British, and Americans from 1540 to the 1850's.
- The history of such Indian tribes as the Blackfeet, Nez Perce, Shoshone, Flathead, Crow, Arapaho, Ute, Paiute, Comanche, Navajo, Zuni, and Apache in their interaction with each other and confrontation with the white culture.
- Military history of the region is represented by sites related to the Civil War, Mexican War, and especially the Indian Wars, in the form of battlefields, forts, and sites where important events occurred.
- Economic, social, commercial, and settlement history, as exemplified in the mountain fur trade (first

Buffalo bones eroding from a dry stream bed in Wyoming. The kill site dates back to 1000-1500 AD.

exploitation of the natural resources of the area); the Santa Fe Trail; the mining frontier (many mines, sites, and towns on Federal land); the cattle and sheep frontier; the farmer's frontier; the history of transportation and communication (especially the transcontinental railroads); and the timber products frontier.

- Overland migration and settlement as seen in the history of the Oregon, California, Mormon, and other historic routes and trails. The rough topography of the entire area limited travel to a few trails in the early days of the development of the West. The topography still limits the routes for roads.

Geologic. The Rocky Mountain Coal Province is the richest of all in terms of human-interest values. The high peaks, deep canyons, tree-covered slopes, and racing streams attract summer visitors to the area by the millions. The mountainous areas with the glacier-carved valleys and cirque lakes are outstanding as scenic values, yet what is seen is merely the results of the natural forces that continue to shape these mountains today.

Apart from the mountains of the area are its deserts, which appeal to a different sort of human interest. Wide-open spaces barren of much vegetation and empty of people and the works of man, scenic expanses, and wind-carved formations of sandstone stand out in the memories of all who experienced them.

The Rocky Mountain Coal Province includes the Colorado plateau and the Grand Canyon of the Colorado River, which unfolds stories of geologic history. The plateau contains many geologic values of interest such as the Petrified Forest and Painted Desert. North and west of the plateau lie the deserts of the Basin and Range lands. This unique area is a series of north- and south-oriented mountain chains that are uplifted blocks of land separated by downdropped blocks to form the valleys. This is the only place in the United States where this is seen on such a large scale. In this area are many enteric basins, remnants of Pleistocene lakes. One such basin exists today at the Great Salt Lake.

Geothermal activity in the province, especially at Yellowstone National Park, is of high human-interest value. Hot springs, which man finds very attractive, abound. Volcanic activity and geothermal values often have a direct relationship. Other than volcanoes and surface lava flows, the public generally does not see any volcanic action except the remains from which the overlying strata have been eroded. These remains are generally seen as curiosities or scenic values such as dikes, necks, sills, and zones of spectacularly colored or shaped rock, shaped and metamorphosed into their present condition by contact with molten lava beneath or on the surface of the earth. Shiprock in northwestern New Mexico is one such example of a volcanic neck and a dike formation. The province has many examples of volcanism throughout, many of which occur on national resource lands and in national parks and monuments. Caves and caverns exist throughout this coal province. Timpanogos Cave National Monument in northern Utah is such a cavern.

The sharp relief of these recently uplifted landforms displays another value of human and scientific interest. Throughout the entire Rocky Mountain Coal Province are places where the rock strata are exposed and show the

This Navajo refuge site dates back to the 1700's.

undisturbed geologic relations of rock in that area. In many places easy access presents valuable opportunities for Americans to learn and enjoy their Nation's geologic character.

Some of these strata, such as the Morrison Formation, are better known for other features. Named for the small town of Morrison, Colorado, where it was first described, this formation has yielded skeletons of dinosaurs and is known to be rich in paleontologic values. Dinosaur National Monument, Florissant Fossil Beds, large fossil deposits near Rock Springs, Wyoming, and frequent vertebrate fossil discoveries in Utah show other values of the Rocky Mountain Coal Province.

Large areas of undisturbed land surface that remain are valuable as a resource in the study of surficial geology. That discipline considers today's land surface features as indicators of the geomorphic past and through study can reconstruct the geologic and erosional history of the earth.

Archeologic. The Rocky Mountain and Northern Great Plains Coal Provinces touch nine states and include parts of four different prehistoric culture areas. The Interior Plateau Culture Area (parts of five states) is best known for its historic tribes. Archeologically this seems to have been a transition area between the Plains and the Northwest Coast Culture Areas. At the time of European contact, the inhabitants had adopted more of the plains culture characteristics than the other cultural influences. The Interior Culture Area extends from western Montana to the Cascade Range on the west. Spanning such a large area, the cultural affinities of the culture subareas change to resemble more closely the proximate, dominant culture.

The Old Cordilleran Tradiation was the progenitor of the plateau people, 9000 B.C. or earlier. These hunters and gatherers gave rise to the culture of the Great Basin people further south. Later, as the environment changed, destroying the bases of the Old Cordilleran Tradition, the Great Basin dwellers, having already adjusted to these changes, spread their influence and culture northward into the interior plateau area. Subsequently, the rise of the Northwest Coast Culture spread its values eastward into this area, with the effect that a riverine way of life was adopted in the west, while in the eastern part of the interior plateau, the plains culture was dominant.

The Desert Tradition of the Great Basin Culture Area had its beginnings in the Old Cordilleran Tradition, from which it separated approximately 8000 B.C. This ancient way of life, built around seed collecting, seed grinding, and small-game hunting, at various times occupied most of arid North America and persisted in purest form down to historic and even modern times. The various branches of this culture spread even to Mesoamerica and to today's Four Corners states, Colorado, New Mexico, Utah, Arizona, where it developed into the component units of the Southwest Culture.

From its Great Basin Desert Tradition beginnings, we recognize the existence of the Cochise culture in southern Arizona and New Mexico by 5000 B.C. Along the Colorado River and in western Arizona, another Desert Tradition group developed about this same time or earlier, the Pinto Basin people. Simultaneously to these developments was the evolution from the Desert Tradition to the San Jose culture in New Mexico and later in the Four Corners area. These Archaic period cultures developed into distinctly different manifestations by the time of the Christian era and at contact had ceased to exist or had merged to become the Indian groups of today.

During the period of 1000-1500 A.D., the Southwest Culture Area was intruded into by Athapascans who, by reoccupying areas abandoned earlier or by pressuring the Puebloid peoples out, became the residents of the Four Corners, eastern Arizona-western New Mexico, and eastern plains of New Mexico. The Paiutes and other Shoshonean speakers of the Great Basin area and the Utes also moved into parts of the southwest not previously in their range.

The archeology of the Northern Great Plains Coal Province includes the western portion of the Plains Culture Area. The earliest dwellers in this area were the Paleo-Indians of the Big-Game Hunting Tradition. These people, the makers of projectile points called Eden, Scottsbluff, Folsom, and Clovis hunted the large mammals of the Pleistocene and post-Pleistocene western plains. At about 4000 B.C., the environment had changed gradually to the point that it was too dry and too warm to support this way of life, and the succeeding peoples formed the Plains Archaic Culture.

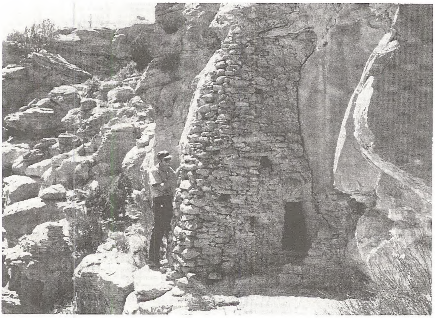
The Big-Game Hunting Tradition at one time extended into Mexico and southeastern Arizona. With the northward recession of the Pleistocene climate and its associated fauna, the big-game hunters also retreated northward and were replaced by an expansion of the Desert Tradition. In the Northwestern and Central Plains subareas the Big-Game Hunters seem to have changed their way of living in situ and became the Plains Archaic who hunted the smaller animals and gathered much of their food from vegetal sources. Later cultural developments on the plains included the introduction of pottery and agriculture with its associated sedentarism and growth of villages and social systems. These elements of culture affected the occupants of the two cultural subareas only marginally, the people remaining essentially in the Plains Archaic level of development until the time of contact with white culture. At that time with the introduction of the horse and firearms they left their wandering, hunting-gathering, and minimally horticultural way of living and reverted to a totally hunting culture.

The prehistoric residents of the Rocky Mountain Coal Province were quite different from one another. Certain things that remain today were basic to their ways of life. Their houses were built of different materials that depended upon the area in which they lived. For the most part they were ephemeral surface structures of poles and brush that were readily abandoned when the time came to move to another area. Common to all cultures are the lithic sites where they obtained stone for tools and left the chips and other debris of tool manufacture. Campsites generally have little cultural depth. However, since succeeding camps would be made within the same area to exploit the wood, water, and shelter resources over a

This is a buffalo trap near Green River, Wyoming.

long period of time, a considerable amount of archeological evidence was deposited within a small area that can yield information much in the fashion of a deeply stratified, long inhabited site. So, while there is no quantitative value that can be established for a single campsite in the barren Great Basin area in comparison to large pueblo ruins of many rooms the campsites could be of considerable archeological value. The importance of both kinds of sites must be realized. Each Culture Area will have unique and valuable cultural remnants that will have to be considered on an individual basis when mineral developement is suggested. An area of three-story pueblo ruins will not be sacrificed to mineral development, but the more subtle archeologic remains must also be safeguarded.

Rock outlines, called intaglios, of the Southern Great Basis area, prehistoric trails, animal traps and kill sites, and stone circles and "Medicine Wheels" of the plains are fragile, irreplaceable examples of Indian heritage. In the southwest are agricultural sites, fields, farmplots and terraces, water diversion structures, fieldhouse structures, irrigation systems, and cave sites that date back to the dawn of agriculture in this part of North America.



A shaft ruin on public lands in New Mexico.

NORTHERN GREAT PLAINS PROVINCE

Of the nationwide total of 530 Federal coal leases, 103 are located in this province.

Geology

Most of the Nation's Federal coal lies within the Northern Great Plains Coal Province (Trumbull, 1960) and (Campbell, 1929), in the Fort Union and Powder River regions located in North and South Dakota, Montana, and Wyoming. This coal province lies wholly within Fenneman's Interior Plains major physiographic division and encompasses the northern part of the Great Plains physiographic province (Fenneman, 1931). The area is mostly characterized by little surface relief, gently rolling plains, some areas of badlands, and dissected plateaus, and isolated mountains. Altitudes range from about 5,500 ft along the western margin of the coal province to about 1,500 to 2,000 ft along the eastern margin in South Dakota. The average slope is approximately 10 ft per mile.

Rocks of the province are mostly sedimentary, range in age from Paleozoic to Tertiary, and rest nearly horizontal, except along the flanks of the Rocky Mountains where they turn up sharply. The sedimentary rocks consist of several thousand feet of sandstone, shale, limestone, conglomerate, and beds of lignite and coal. Many of these sedimentary units are quite thick and extensive. Some were deposited on the floors of ancient seas that extended across the continent and others were deposited in deltas or tidal areas along the margins of the seas or inland in broad depositional basins. Coal formed in tidal swamps and marshes along the marine shores and also in swamps, lakes, and on the flood plains of major drainage systems of inland basins. These basins developed after the continents were uplifted and the seas retreated.

North-Central Coal Region. The North-Central Region of Trumbull (1960) includes all the coal-bearing lands of the north central part of

Montana. This region was separated into the *Assiniboine* and *Judith Basin* regions by Campbell (1929).

The *Judith Basin* portion of this region includes the Great Falls and Lewistown fields. In this area, coal beds are contained in the upper part of the Morrison Formation of Late Jurassic age. The coal is high-volatile bituminous B and C in rank, but contains 1.7 to 4 percent sulfur, somewhat higher than coals of the other regions in the West.

The *Assiniboine* area of this region surrounds the Bearpaw Mountains and includes 10,500 square miles of nearly flat-lying, coal-bearing rocks of the Upper Cretaceous Judith River and Eagle Sandstone Formations and the Paleocene Fort Union Formation. The coal ranges from subbituminous A and B rank to high-volatile bituminous B and C rank, but in most places, the beds are discontinuous and too thin to be of commercial importance other than as a local source of fuel.

Coal-bearing rocks also crop out in the Blackfoot-Valier area west of the Assiniboine region along a belt extending from Cascade County in west central Montana to the Canadian border. Coal beds 2 to 3.5 ft thick of Upper Cretaceous and Paleocene age are contained in rocks of the Two Medicine and St. Mary River Formations, but generally they are too thin and sporadic to be of commercial interest.

Two other Montana coal areas in the northern part of the province are the Bull Mountain and Garfield County coalfields. The coal-bearing rocks are in the same formations as in the nearby Fort Union and Powder River regions, but the coal beds are generally thinner and less extensive.

Fort Union Coal Region. The largest region in the Northern Great Plains Coal Province is the Fort Union Region encompassing the western half of North Dakota and parts of South Dakota and Montana. This region contains an estimated 440 billion tons of lignite, by far the largest coal resource in the entire United States, (Averitt, 1963, 1969, 1973; Brown, 1952; Berryhill, Brown, Brown, and Taylor, 1950; and Landis, 1973).

The region occupies a very broad, shallow basin with Tertiary rocks dipping slightly toward the center. In the South Dakota part of the basin, some gentle smaller flexures are superimposed on the major depression. Dips are less than one degree and nowhere are there structural disturbances of sufficient magnitude to cause serious mining problems. Faults are rare in this region.

Most of the coal is contained in the Lebo, Tongue River, and Sentinel Butte (in North Dakota), members of the Fort Union Formation of Paleocene Age. A few thin beds are also contained near the base of the overlying Wasatch Formation and in the underlying Paleocene Tullock member of the Fort Union Formation and Late Cretaceous Hell Creek Formations. The coal beds are discontinuous and vary greatly in thickness. More than a hundred coal beds have been identified by the North Dakota State Geological Survey, but in any one section no more than three beds of commercial thickness have been found. The Fort Union formation ranges from 425 to 775 ft thick in South Dakota to 1,500 ft thick in Montana. The coal throughout most of the Fort Union region is lignite in rank. However, westward from the Montana-North Dakota state line, the rank of the coal increases to subbituminous C near Miles City and subbituminous B further to the west. The Fort Union region merges with the Powder River region along this vague northwest-trending boundary defined by the rank change from lignite to subbituminous.

Powder River Coal Region. The Powder River region is the southern extension of the Fort Union region, and it continues from southern Montana into northeastern Wyoming. The region encompasses an area of about 20,000 square miles and contains nearly 240 billion tons of subbituminous coal resources (Glass, 1972; and Berryhill, et al. 1950).

The Powder River basin is a broad gentle structural trough lying between the Big Horn mountains to the west, the Black Hills uplift to the east, and the Laramie mountains and Hartville uplift to the south.

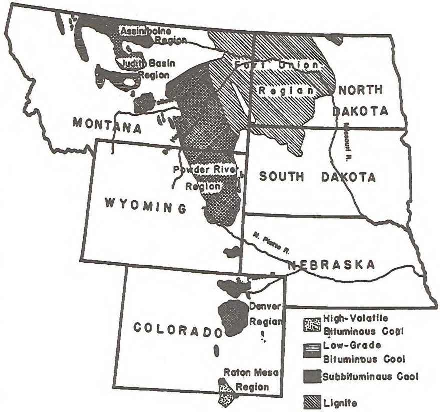


Figure 2-10. Northern Great Plains Province.

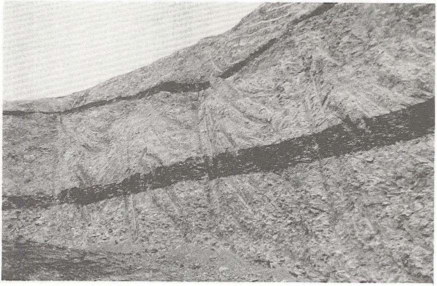
The basin is asymmetrical with rocks dipping 5° or less along the eastern side and considerably steeper along the western and southwestern sides. Most of the coal-bearing rocks crop out away from the more steeply dipping edges of the basin and are characterized by nearly flat or gentle dips beneath a gently rolling or dissected plain. Red-weathering "clinker" beds of burned overburden along the coal outcrop zones are more resistant to erosion than the enclosing strata and form prominent distinctive caps and ledges throughout the region.

The Fort Union Formation consists of 1,700 to 3,200 ft of sandstone, shale, and coal and is divided into the Tullock member at the bottom, overlain by the Lebo Shale member, with the Tongue River member, the thickest unit, at the top. The Wasatch Formation ranges from 1,050 to 3,500 ft thick and consists of sandstone, shale, and coal with beds of conglomerate at the base along the western margin.

Coal of commercial interest is contained in the Tongue River member of the Fort Union Formation of Paleocene age and also in the overlying Wasatch Formation of Eocene age. Some thin impure coals are also reported in the underlying Lance Formation of Late Cretaceous age, but presently they are of little commercial interest.

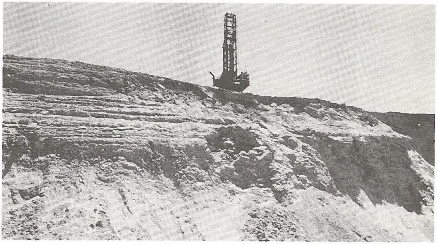
In general, the coal beds are thickest in the northern parts of the region and most persistent across the gently dipping northern and eastern sides of the Powder River Basin. Some of the important coal beds in the region are the Badger and School seams at Glenrock, the Monarch seam near Sheridan, the Healy bed near Lake DeSmet, the Felix and Anderson beds in the Spotted-Horse field, and the famous Wyodak seam or "0" bed near Gillette. Regional correlations of these and other coal beds are being revised, but it remains certain that the Wyodak or "O" bed and it correlatives persist as a thick and continuous bed over several thousand square miles with recoverable reserves of many billion tons.

The Black Hills portion of this region extends from the Cambria coal field near Newcastle, Wyo., around the west and north sides of the Black Hills uplift into South Dakota. This area is a dissected plateau tilted slightly away from the Black Hills uplift. The plateau is underlain by the massive Dakota Sandstone of Early Cretaceous age, which is 150 to 300 ft thick and locally coal bearing. The coal is high-volatile C bituminous, and though locally as thick as 10 ft, it occurs in discontinuous pods and lenses and is of little commercial interest. About 10 million tons of good coking coal were produced in the past from the Cambria field (Berryhill, et al., 1950).



The Fort Union Formation extends into North Dakota. The photo is of two seams along the high wall of the Glenharold Mine at Stanton, N.D.

Denver Coal Region. The Denver region extends from the Colorado-Wyoming state line southward across east-central Colorado as far as Colorado Springs. Physiographically, this area falls within the Colorado Piedmont section of the Great Plains. The region includes 8,000 square miles of gently rolling plains underlain by coal-bearing rocks of the Laramie Formation of Upper Cretaceous age. It occupies a north- and south-trending asymmetrical basin characterized by gentle dips on the east flank and steeply upturned beds along the Rocky Mountain front to the west. The coal beds occur at depths probably less than 1,000 ft throughout the region. The coal seams occur in the lower 300 ft of the Laramie Formation. They are mostly subbituminous B to C in rank and as thick as 17 ft,



The Western Energy Mine. Mine is in the Fort Union Formation at Colstrip, Montana. This rig is drilling holes to blast overburden.

but most are thinner, lenticular, and discontinuous.

There are extensive beds of lignite in the Denver Formation of Late Cretaceous and Paleocene ages. In parts of the region, coal beds also are contained in the Late Cretaceous Arapahoe Formation, but these coals are very lenticular, generally quite dirty, and of lower rank, bordering on lignite (Hornbaker & Holt, 1973).

Raton Mesa Coal Region. The Raton Mesa Coal region occupies a large part of the Raton basin, a broad structural trough that trends in a north-south direction from northern New Mexico into southern Colorado. The basin is an asymmetrical syncline characterized by gently dipping rocks on the eastern flank and steeply dipping to overturned rocks along the flanks of the Sangre De Cristo Mountains to the west. The area contains many igneous dikes and sills of intermediate composition that alter and destroy coal beds they intrude.

Coal occurs throughout the sandstones and shales of the Vermejo Formation of Upper Cretaceous age and the conglomerate, sandstone, and shales of the Raton Formations of Upper Cretaceous and Paleocene age. The coal is high-volatile A to B bituminous in rank and will coke throughout most of the region, except in the Walsenburg field in the northern part.

The coal-bearing rocks are as thick as 2,400 ft and contain coal beds mostly 2 to 5 ft thick, but ranging as thick as 15 ft in the New Mexico portion of the region. Much of the coal crops out at the surface on hillsides and along hogbacks. Some stripping coal reserves are reported, but some of the major coal beds of the Vermejo Formation are buried by overburden as thick as 1,000 to 3,000 ft (Pillmore, 1969).

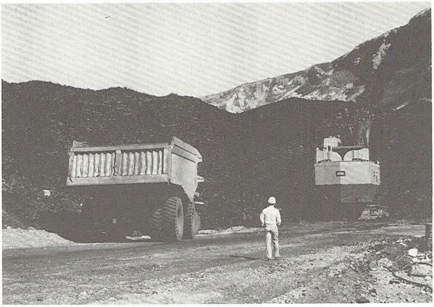
North of the Raton Mesa Region, the *Canon City Coal Fields* contains as many as 16 beds of noncoking high-volatile C bituminous coal in rocks of the Vermejo Formation in a similar, but smaller scale, structural setting.

Topography

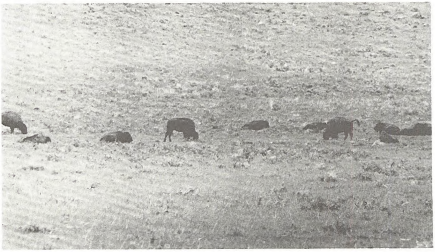
Topography of the Northern Great Plains Coal Province is predominantly rolling hills, plains, and some areas with breaks or sharply eroded hills. Elevations range from 5,000 ft on the west to about 2,000 ft above sea level along the eastern boundary of the province. The streams in general drain easterly to southeasterly. Average slope is about 10 ft per mile. The main rivers of the area are the Missouri, Yellowstone, and Platte. Each of these rivers has numerous tributaries, especially the Missouri River. There are several isolated, small mountainous areas such as the Black Hills in South Dakota and the Bearpaw, Little Rockies, Judith, Bull, Big Snowy, and Little Belt Mountains in Montana. Some other significant topographic features of this province include the Sand Hill area of west central Nebraska, the badlands of southwestern South Dakota, Devil's Tower in northeastern Wyoming, glaciated areas of Montana and North Dakota, and the Little Missouri Badlands of western North Dakota. The Missouri River in northern Montana has cut into the soft shale, perhaps 500 ft below the tops of the rims. This area is known as the Missouri breaks.

Climatology

The Northern Great Plains Coal Province has a continental climate. The average annual precipitation varies between 8 and 24 in. By far the largest



Loading coal at Dave Johnston mine in Wyoming's Powder River Basin.



Buffalo graze in the Powder River Basin.

Burlington Northern Railroad right-of-way near Sarpy Creek in Montana. The pipe in the photo is for culverts.

The Little Missouri Badlands of western North Dakota. The topography of the Northern Great Plains Coal Province is predominantly rolling hills, plains and some areas with breaks or sharply eroded hills.

portion of the area receives between 10 and 16 in. The eastern portion of the area in the Dakotas and Nebraska, along with the mountainous areas, receives more than 16 in. The precipitation is heaviest along the eastern boundary and lightest in the north central area. The precipitation is heaviest in April to September, when the monthly average may exceed 2 in. The summer rains are usually out of the south from the Gulf of Mexico. They usually come in the form of thunderstorms. The prevailing wind pattern is out of the west or northwest. The western portion of the area is noted for its wind. The area normally receives less than one inch of precipitation per month in the winter. This is in the form of snow. The frequent high winds cause the snow to drift. The drifted snow can be a major problem for livestock and travel.

Temperatures range from 50° below zero to 110° above zero. Mean daily temperatures range from 10° in January to 70° in July in the northern portion. Along the southeastern boundary, the mean daily temperatures range from 20° in January to 80° in July. The freeze-free days range from 90 in the north to 140 in the southeast. The average annual snowfall varies from 20 in. to 60 in. The January humidity of the area averages between 60 and 75 percent. The summertime humidity averages between 40 and 65 percent.

Hydrology

Northern Great Plains Province. All streams in the northern Great Plains Coal Province are in the Northern Missouri River Basin. The average annual runoff to streams in the province ranges from less than 1 in. in some of the structural basins to over 10 in. in the eastern part of the Big Horn Mountains. Most of the larger streams draining the area are perennial, while most of the smaller tributaries are intermittent. The Missouri River and its major tributaries obtain most of their water outside the province. The Rocky Mountains to the west of the province is the major source of runoff to these large streams. The province is vulnerable to droughts of up to several years duration.

The total dissolved solids in surface waters in the province ranges from less than 100 mg/l in the more mountainous headwater areas to more than 1,800 mg/l on many tributary streams. The amount of dissolved solids in a watercourse is affected by the type of soil and rock in the region, the length of time the water has been in the watercourse, and the extent to which the flows are affected by other water sources. Although the specific chemical composition is an important consideration in determining whether water can be used for specific purposes, the total amount of dissolved solids in the water generally is the controlling factor as to whether a water supply is chemically suitable for most general uses.

The average suspended-sediment concentrations in streams in the province ranges from less than 200 parts per million (ppm) in the mountainous parts of the province to more than 30,000 ppm during peak flows on tributaries within the basin. The suspended sediment in the stream is comprised of particulates such as sand and silt. The ability of streams to carry suspended sediment increases with stream velocity. Suspended sediment tends to be greater in areas where the

soil is not held in place by dense vegetative cover.

Groundwater in this province occurs in alluvium, glacial drift, and bedrock aquifers. Alluvium in the region generally is a good aquifer. This flood-plain alluvium is capable of yielding moderate amounts of groundwater to wells (a few hundred gpm) and as much as several thousand gpm to wells in a few places. The quality of water in the alluvium generally is acceptable for most uses. In the northern part of this province, glacial drift mantles the consolidated sedimentary rocks. Glacial drift is detrital material deposited by glacial ice and glacial melt water and may range in thickness from 0 to more than 200 ft within the province. Only locally does the glacial drift yield more than moderate amounts of water to wells. Glacial outwash, which is glacial drift that has been sorted and redeposited by streams, yields moderate to large amounts of water at some places. This water generally is of acceptable quality although in some areas, it may contain over 1,000 mg/l of dissolved solids.

The principal and most widespread bedrock aquifers in the province are beds of sandstone and limestone. Yields of most sandstone aquifers are low to moderate, while the highly variable limestone aquifers may yield up to 1,000 gpm to wells. In general, where the aquifers are highly permeable, good quality water is obtained even to depths of 1,000 ft or more. However, where the aquifers have low permeability, highly mineralized water is obtained even at shallow depths. Some shallow coal beds in the province are aquifers and can supply enough water for domestic use.

Many large areas in this province, including areas underlain by coal, have no nearby perennial surface water supplies, and the groundwater supplies are limited or of poor quality.

North Central Region. The Missouri River is the main stream draining the region. The Judity River, Teton River, Milk River, and Marias River are the main tributaries of the Missouri River in this region. The quantity of surface water available in this region is highly variable, especially on the smaller tributaries. Many of the drainage areas of tributaries underlain by coal are dry most of the year. The quality of surface water is generally good in the larger streams in the area. Most of the surface water is a calcium bicarbonate type. The streams in this region generally have high sediment concentrations, especially during periods of peak flow. Many of the smaller intermittent tributaries have sediment concentrations of over 30,000 ppm during peak flows.

The availability of groundwater in the region is highly variable as to quantity and quality. In the northern part of the area, glacial drift covers much of the surface. Yields from the glacial drift are generally poor, except in scattered areas of glacial outwash. Alluvial deposits yield small to moderate amounts of generally good-quality water in many parts of the region. In the unglaciated part of the region, bedrock aquifers are believed to contain good-quality water. Little information is available on the groundwater in bedrock aquifers underlying areas covered with glacial drift, but they are believed to contain poor-quality water.

Fort Union Region. Most of the Fort Union Region is drained by the Missouri River and its tributaries. The surface water originating in most of the area has relatively high concentrations of dissolved solids and is a sodium bicarbonate type. The sediment yield of tributary streams is high because the shales and sandstones in the area are easily eroded.

The best source of groundwater in the region is from alluvium. Wells tapping the alluvium in the preglacial valley of the Missouri River yield over 1,000 gpm at many locations. The water is generally of acceptable quality, but locally it may be highly mineralized.

Groundwater from the glacial drift in the northern part of the region is generally of poor quality. The shallow bedrock aquifers in the region yield limited quantities of acceptable quality groundwater.

Other water-bearing rocks are present at lower depths, but the water is thought to be brackish.

Powder River Region. The major streams draining the Powder River Region are the Powder River, Belle Fourche River, Cheyenne River, and North Platte Rivers. The quality of water available from these streams varies considerably. During maximum runoff periods, the dissolved solids content of the water is generally low and suitable for most uses. However, during low flow periods, the dissolved solids content of the waters can increase to over 2,000 mg/l. Some of the tributary streams in this region contribute a very high level of dissolved solids to major drainage systems after intense thundershowers.

Sediment concentrations in streams of the region varies from moderate to high. The Powder River breaks area, a broad band of badlands along the Powder River, is subject to extensive sheet and gully erosion and contributes much sediment to the stream.

Groundwater supplies from alluvial deposits along the major streams in the area yield medium to large supplies of water to wells. The water is generally of acceptable quality for most uses. Pumpage from the alluvial aquifers can deplete streamflow during dry periods and affect downstream water rights. However, dewatering alluvial aquifers permits increased storage of flood runoff in these aquifers. Many of the alluvial aquifers along intermittent tributary streams may yield medium quantities of poor-quality to highly saline water. Bedrock aquifers in the region generally yield small quantities of acceptable quality water, especially around the edges of the basin. As the center of the basin is approached, the aquifers generally yield more mineralized water. The potential of the bedrock aquifers in the region has not been fully evaluated. It is believed that in parts of the region, some of the limestones may yield large quantities of good-quality water.

Water is so scarce in this region that proposals to develop coal here include plans for large water diversions from outside the Powder River Basin.

Denver Basin Region. The Denver Basin Region is drained by the South Platte River and its tributaries. The headwaters of the South Platte lie outside the Denver Basin Region and consist of several tributary streams draining the Rocky Mountains. In the mountainous headwater areas, the water is generally of good quality, with dissolved solids contents of less

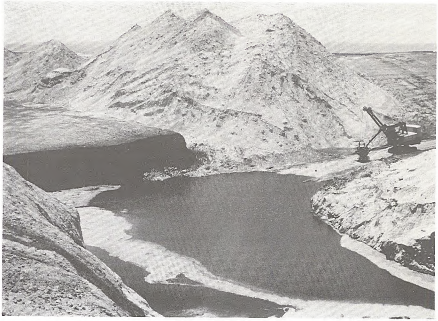
than 100 mg/l common on most tributaries and the main stream. Most of the tributaries draining the Denver Basin itself are intermittent and contribute only a small percentage of the total flow. These tributaries also have high dissolved solids contents, with values of 1,000 mg/l or more common. In the headwater areas, the streams generally are a calcium bicarbonate type, while by the time the South Platte River leaves the Denver Basin, it contains an average of over 1,000 mg/l dissolved solids and the major ions present are sodium, calcium, sulfate, and bicarbonate.

Sediment concentrations are generally low in the mountainous headwater areas during low to medium flows. However, during high flows, high sediment concentrations are common, especially on tributaries disturbed by past mining operations. Within the Denver Basin, most tributaries have high sediment yields during peak runoff periods.

Groundwater aquifers in the region are mostly river alluvium. Bedrock aquifers are present in the northern part of the Denver artesian basin. The groundwater supplies in the alluvium are used predominantly for irrigation. Wells along the main streams yield from 400 to 2,000 gpm and average about 900 gpm; wells in the tributary valleys yield 50 to 1,800 gpm and average about 800 gpm.

The groundwater in the river alluvium deposits along the main stream tends to deteriorate in quality downstream. The average dissolved solids content near Denver is about 1,300 mg/l; at the state line, it is about 1,800 mg/l. The water is usable for irrigation, but some of it has a high salinity hazard.

The bedrock aquifers consist of sand, sandstone, gravel, and conglomerate of Late Cretaceous and Tertiary age. Generally, several horizons will yield water to wells. The yields of individual aquifers ranges from 1 to 100 gpm. The water in most areas is under artesian pressure. In some areas, intense pumping has lowered the artesian head more than 600 ft. The water is generally a sodium type and is of good quality. Locally, the mineralization is high because of structural conditions that impede ground water circulation.

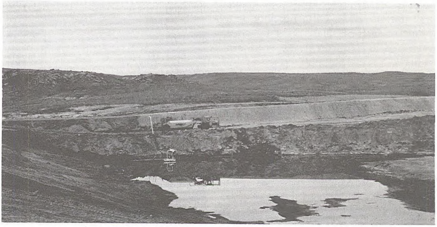


Surface water is collected in a mined out pit. It can be used to suppress dust on the roads at the Dave Johnston mine near Glenrock, Wyoming.

Soils

Soils within the Northern Great Plains Coal Province are subdivided into coal regions. Tables 2-9 through 2-11 list some dominant soil series that occur in each particular area for each region or for two regions with similar soil. Some characteristics, uses, and limitations are given for each of the listed soil series. Specific items for each soil such as the unified classification of the subsoils for engineering uses and hydrologic groups are given as well as general information. Thus, the information may be used by engineers, hydrologists, and soil scientists as well as the general public to gain some knowledge of the soils. The listed soil series are not inclusive. They occur extensively in the region under which they are identified, but they must be viewed as examples. A detailed, on-site soil survey must be made before the total soil resource is known. More detailed information of soil characteristics and limitations may be obtained from the soil survey reports listed in the selected references.

Descriptions of soil organisms for this province are the same as for the Pacific Coast Coal Province.



Seepage at Amax Mine near Gillette, Wyoming.

Vegetation

Plants of the Northern Great Plains Province are mostly grasses. Principal species in the northern part of the province are wheatgrasses (primarily western wheatgrass, often a sod former), needlegrasses, blue grama (another sod grass), and fescues. As a result of prior overgrazing during the growing season by grass-eating livestock (and possibly by bison before them), blue grama, sagebrushes, and rabbitbrushes have increased in these grasslands. Lower forms of plant life sometimes protect the soil in the thinned stands of grass. Fringed sage (a half-shrub), and prairie globemallow (a forb), are important nongrass plants. Plains prickly pear is noticeable.

All the grasses, except blue grama (a warm-season grower), do well because of the temperature and precipitation patterns. Seventy percent of the precipitation falls as rain during the April-October growing season. This is especially true in eastern Wyoming and Montana and western North Dakota, with 12 to 16 in. total precipitation.

The northern coal regions in the Northern Great Plains Province also include small areas of the cold-desert biome dominated by sagebrush. In addition, some areas are dominated by the ponderosa pine portion of the montane coniferous forest biome. Under the pine, either grasses or shrubs may predominate or they may be mixed. Cottonwood, willow, and elms of the deciduous forest biome dominate the bottoms along the rivers and their tributaries.

Further south, the Denver coal region is mostly covered by blue grama and buffalo grass, quite possibly as a result of historic overgrazing by grass eaters in this hotter, more southern climate. Yucca, probably increased by overgrazing, is present. Western wheatgrass, needle and thread (or needlegrass), fringed sage, and prairie globemallow are present here, too. Four-wing saltbrush is found along drainage systems and inland saltgrass indicate soil alkalinity or salinity. Sand sage and prairie sand reed, a grass, are in sandy areas. Plains prickly pear is present.

In the Raton Mesa region are pine, inland Douglas-fir, and spruce-fir types of the montane coniferous forest. Pinon-juniper stands of the woodland-bushland biome are present. Short grass plains similar to those of the Denver coal region occur (Kuchler, 1966).

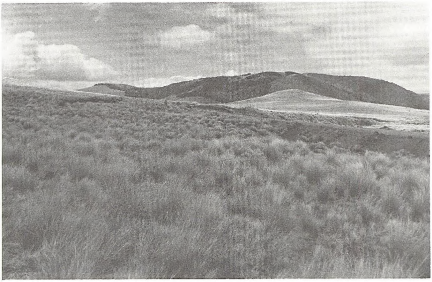
Wildlife

The Northern Great Plains Coal Province is located within the short grass plains of the grassland biome and has a grassland fauna similar to that described by Kendeigh in 1961. This province is bordered closely on the west by the montane coniferous forest biome. The ecotone between the two biomes along the western part of the province is inhabited locally by animal species characteristic of the montane coniferous forest and of the forest edge. A distinct plant community, riparian woodland, of willows, cottonwoods, aspen, boxelder and other broad-leafed deciduous trees occur along streams, bodies of water, and elsewhere. The animals associated with this plant community are characteristic of the deciduous forest edge (Kendeigh, 1961).

The wildlife of this coal province then, is a composite of the native, terrestrial animal associations, the aquatic animals of the stream, lake and pond-marsh communities, and the introduced species present.

Terrestrial Wildlife. The high annual turnover of net primary production in the grassland communities provides a food base for a large variety of animals. Grazing animals, burrowing animals, swift-running animals, and ground-nesting birds are characteristic of the grasslands. Insect life is abundant, varied, and heavily utilized as food for many secondary consumers. Large herbivores such as bison and antelope were present in great number during presettlement times. Today, bison have been replaced by domestic livestock as the primary grazing ungulates. Grazing horses, cattle, and sheep often live in competition with native herbivores. Practices used in livestock production have sometimes disrupted the natural function of the grassland ecosystem to the deteriment of various wildlife species. Examples are predator and rodent control programs and sagebrush eradication in antelope or sage grouse winter areas. Antelope are still fairly numerous in the grasslands of this coal province. Investigations have shown that they are highly dependent upon the brush and forb components of the grassland for survival (Sundstrom, Hepworth, and Diem, 1973). Drought and severe winter storms periodically occur, and the population of some wild animals can fluctuate widely from year to year.

In the ecotone area between the montane coniferous forest and the grassland biome, animal species characteristics of the coniferous forest and of the forest edge will often be found living in close proximity to grassland



Grass characterizing the Northern Great Plains Coal Province.

animals. Some of these animals, such as the mule deer and elk, occur on extensions or scattered islands of coniferous forest and related subtypes within the grassland. Examples of these areas are noted in the Powder River Breaks of Wyoming, the Bull Mountains of Montana, the Little Missouri River Breaks in North Dakota, and several others. The wildlife composition of these nongrassland habitats is a reflection of the food, cover, and living space available. These habitats may be marginal for some species in particular areas. The Powder River Breaks elk herd in Wyoming is a good example. This small herd survives in an area with few trees and little escape cover other than topography. It is suspected that they are able to survive here primarily because the breaks provide relative isolation from civilization at the present time (Bureau of Land Management, Casper District, 1973).

The deciduous forest-edge biociation extends into the short grass plains along the major stream drainages supporting the riparian woodland community. As the interior of the continent grew arid in prehistoric times, many species of deciduous trees together with their associated animals were able to persist along the stream. These "tongues" of forest greatly extend the forest edge into the grasslands. Some species are common to the deciduous forest edge over most of its range, and others are found only in the western portion of this biociation (Kendeigh), 1961). The presence of the riparian woodland within the shortgrass plains

Table 2-9

Some Characteristics, Uses, and Limitations of Dominant Soils Occurring in the Powder River Region of the Northern Great Plains Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Cabba	Montana (USDA, 1971)	ML	2-3	C	15-50	mild & short grasses	rangeland
Limitations – Shallow to shale, low fertility, moderate to severe erosion hazard, cold soil temperatures.							
Elso	Montana (USDA, 1971)	ML	2-3	D	8-45	short grasses	rangeland
Limitations – High wind-erosion hazard, low fertility, shallow to shale.							
Farland	Montana (USDA, 1971)	ML	8-10	B	2-8	bay, grain, grasses	dryland crops & range
Limitations – Slight to severe water-erosion hazard, severe wind-erosion hazard, high fertility.							
Haverson	Montana (USDA, 1971)	ML or CL	9-11	B	0-4	hay, small grains	cropland
Limitations – Severe wind-erosion hazard, moderate fertility.							
Hesper	Montana (USDA, 1971)	CL	10-12	C	0-15	grasses, small grains	rangeland
Limitations – Moderate erosion hazard, clayey soil.							
Hydro	Montana (USDA, 1971)	CL	10	C	0-8	grasses, small grains, hay	rangeland & dry-land farming
Limitations –							
Midway-Elso	Montana (USDA, 1971)	CL or CH & ML	1-3	D	8-35	grasses	rangeland
Limitations – Erosion hazard is moderate to severe. Shale occurs about 10 in. deep. Gullied, low fertility, clayey textured.							
Midway-Elso	Montana (USDA, 1971)	CL or CH & ML	3	D	35-75	grasses	rangeland
Limitations – Erosion hazard is very severe, area is entrenched with gullies, much shale and sandstone outcroppings, low fertility, clayey textured.							
Ringling-Cabba	Montana (USDA, 1971)	GM or SM & ML	1-2	C	15-50	grasses	rangeland
Limitations – Slight to moderate erosion hazard, shallow to shale, low fertility, contains over 35 percent coarse fragments.							

Table 2-10
Some Characteristics, Uses, and Limitations of Dominant Soils Occurring in the Raton Mesa and Denver Regions of the Northern Great Plains Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Bresser	Colorado (USDA, 1971)	SC or SM	6-9	B	0-20	winter wheat, alfalfa	cultivated crops
Limitations – Wind-erosion hazard is severe, water table about 10 ft. deep, sandy subsoils.							
Fondis	Colorado (USDA, 1971)	CL	9-12	C	1-9	wheat, grasses	cropland, residential
Limitations – High fertility, moderate erosion hazard, compaction layer forms easily, clayey soil.							
Nunn	Colorado (USDA, 1971)	SM	9-12	C	0-3	small grains, alfalfa, corn	cultivated crops, residential
Limitations – Moderate wind-erosion hazard, occasional flooding, slight water-erosion hazard, clayey soils.							
Weld	Colorado (USDA, 1971)	ML-CL	9-12	C	0-5	small grains, alfalfa, corn, grass	cultivated crops, range
Limitations – Moderate wind-erosion hazard, slight water-erosion hazard, clayey soils.							
Ascalon	Colorado (USDA, 1968)	CH	2-6	B	0-9	small grains, sared bluestem	dryland crops, rangeland
Limitations – Lime layer occurs about 15 in. deep. Wind- and water-erosion hazards are moderate to severe.							
Bijou	Colorado (USDA, 1968)	SP	4-8	A	0-3	onions, small grains	cropland
Limitations – Sand layer about 45 in. deep. Wind-erosion hazard is severe.							
Dune land	Colorado (USDA, 1968)	SP	3-6	A	5-25	sparse grass	limited grazing
Limitations – Dunes are actively blowing, very severe wind-erosion hazard.							
Heldt	Colorado (USDA, 1968)	CL	4-8	C	0-3	saltgrass, blue-gramma & small grains	cropland, rangeland
Limitations – Saline soils, some slickspots, slow permeability, high seasonal water table, high compaction hazard. Clayey soils.							
Valentine	Colorado (USDA, 1968)	SP	2-6	A	1-25	sandreed, sand bluestem	rangeland
Limitations – Very severe wind-erosion hazard, very sand soil. Vegetation easily destroyed.							
Campus	Colorado (USDA, 1969)	ML	2-4	B	0-5	winter grains	dryland farming
Limitations – Pan exists at about 15 in., severe erosion hazard.							
Richfield	Colorado (USDA, 1969)	ML	4-6	C	0-5	winter grains, grasses	dryland farming, rangeland
Limitations – Moderate compaction and erosion hazards.							
Slickspots	Colorado (USDA, 1969)	CL	–	D	0-1	saltgrass, alkali sacaton, switch grass	pasture
Limitations – Saline soils, water table about 50 in. deep, very severe restrictions to management.							

Table 2-11

Some Characteristics, Uses, and Limitations of Dominant Soils Occurring in the North-Central and Fort Union Regions of the Northern Great Plains Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Cherry	Montana (USDA, 1973)	CL	12	C	0-25	crops, grasses	cropland, rangeland
Limitations – Slight to moderate erosion hazard. Poor roadfill material.							
Farnuf	Montana (USDA, 1973)	ML, or CL	6	B	0-8	crops, grasses	cropland, rangeland
Limitations – Slight erosion hazard, susceptible to frost heaving.							
Lambert	Montana (USDA, 1973)	ML	12	B	2-65	crops, grasses	cropland, rangeland
Limitations – Moderate to severe erosion hazard, susceptible to frost heaving.							
Norbert	Montana (USDA, 1973)	CH	3	D	8-65	grasses, juniper	rangeland
Limitations – Clayey soil, 13 in. to shale bedrock, severe erosion hazard, severe limitations for most uses.							
Tinsley	Montana (USDA, 1973)	GW	1	A	15-65	grasses	rangeland, sand & gravel
Limitations – Gravelly, sandy, droughty soils, severe wind-erosion hazard. Soil is 4 in. deep to sand and gravel.							
Turner	Montana (USDA, 1973)	SW, or GW	2	B	0-8	crops & grasses	cropland, rangeland
Limitations – Sand and gravel occur from 20 to 40 in., severe wind-erosion hazard.							
Williams	Montana (USDA, 1973)	CL	12	B	1-8	crops	cropland
Limitations – Slight to moderate erosion hazard.							
Badland	Montana (USDA, 1973)	–	–	–	15-100	some grasses	limited grazing
Limitations – Very severe erosion hazard, severe limitations to most uses.							
Bainville	North Dakota (USDA, 1968)	CL	2	C	3-40	crops & grasses	cropland, rangeland
Limitations – Severe wind- and water-erosion hazard, over clayey shale, low natural fertility.							
Morton	North Dakota (USDA, 1968)	ML, or CL	9	B	0-15	crops	cropland
Limitations – Moderate erosion hazard, underlain by silty shale.							
Bowbells	Montana (USDA, 1973b)	ML, or CL	9	B	2-4	grasses, legumes, & crops	rangeland, cropland
Limitations – Slight erosion hazard, slight limitations for most uses.							
Havrelon	Montana (USDA, 1973b)	ML, or CL	9	B	0-2	small grains, grasses, grass hay	cropland, range land
Limitations – Cold soil temperatures, calcarious, slight erosion hazard, salt-tolerant vegetation is required.							
Fargo	Montana (USDA, 1967)	CH	–	D	0-3	sedges & rushes	pasture
Limitations – Poorly-drained, calcarious clays, high water table, slight erosion hazard. Severe compaction hazard, soil management is very difficult.							

greatly increases the variety of ecological niches available for animals. Animals requiring heavy escape cover, shade, browse, tree-nesting sites, etc. are able to survive within the grasslands.

Specific mention should be made of the importance of the sagebrushes to some wildlife species within the Northern Great Plains Coal Province. Sagebrush is prominent in the vegetation composition in parts of the grassland, especially in the Powder River Region of this province. Sage grouse are limited almost entirely to areas of abundant sage growth. They use sagebrush for food, nesting, resting, and brooding. Certain sagebrush areas are highly important as nesting and wintering areas. Sage grouse will sometimes use farm lands adjacent to their native habitat. However, they are basically dependent on the sagebrush and cannot survive in areas that lack that vegetation (Fish and Wildlife Services, 1952). Pronghorn antelope are heavily dependent upon the sagebrushes, especially Wyoming big sagebrush and silver sagebrush (Sundstrom, et al. 1973). Brewer's sparrow, a common resident of the sagebrush grassland, appears to be quite dependent upon cover provided by sagebrush for nesting. Studies in Montana showed significant reduction in nesting pairs of Brewer's sparrows with sagebrush eradication (Best, 1972).

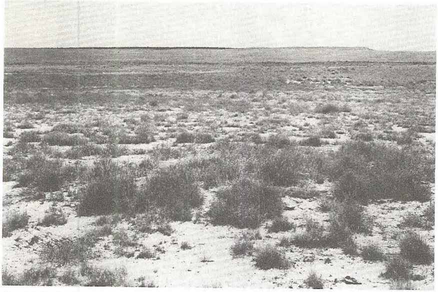
Some man-introduced species have become well established in parts of this coal province. Chuckar partridge have adapted well to areas of rough breaks. Hungarian partridge have done well in some portions of the Fort Union region of the province. The ring-necked pheasant is plentiful in cropland areas where good winter cover is intermixed. Wild turkeys have been established in some of the broken woodland areas of the Powder River and Fort Union Regions where they had not occurred historically.

Conspicuous terrestrial anaimals found within the Northern Great Plains Coal Province include the following representatives of different biotic communities. Mammals include the masked shrew, the white-tailed jackrabbit (northwest), the black-tailed jackrabbit (southeast), the desert cottontail, the black-tail prairie dog, ground squirrels, the northern pocket gopher, the plains pocket gopher (south), the meadow vole, the coyote, the swift fox, the long-tailed weasel, the black-footed ferret, the badger, the prairie spotted skunk, and the pronghorn antelope. Reptiles include the prairie rattlesnake and the eastern short-horned lizard. Birds include the ferruginous hawk, prairie chickens, the sharp-tailed grouse, the mountain plover, the burrowing owl, the horned lark, the western meadowlark, the lark bunting, the savannah sparrow, the grasshopper sparrow, the vesper sparrow, and mccown's longspur.

Montane Coniferous Forest and Forest-Edge mammals include the yellow-bellied marmot, the golden-mantled ground squirrel, least chipmunk, the red squirrel, the bushy-tailed wood rat, the boreal redback vole, the bobcat, the mule deer, the wapita (elk), and the porcupine. Birds include the golden eagle, the western flycatcher, Clark's nutcracker, the mountain chickadee, the mountain bluebird, and

As a result of prior overgrazing during the growing season by grass-eating livestock and, possibly by bison before them, blue grama, sagebrushes and rabbitbrushes have increased in these grasslands.

Eastern Colorado Plains.



Overgrazing in the Denver Coal Region.

the pygmy nuthatch. The deciduous forest-edge community (riparian woodland) of animals includes the red fox, the white-tailed deer, the fox squirrel, the eastern cottontail, the striped skunk, the raccoon, the blue racer, the milk snake, the red-spotted garter snake, the turkey vulture,the sharp-skinned hawk, Cooper's hawk, the red-tailed hawk, Swainson's hawk, the mourning dove, the common nighthawk, the red-shafted flicker, the violet-green swallow, the common crow, the black-billed magpie, the loggerhead shrike, and Brewer's blackbird.

Insufficient information is available concerning the identification and status of a variety of invertebrate populations known to exist in this province. This fact, and the scope of this statement, present more than some superficial comments pertaining to a few members of this group.

Aquatic Wildlife. Aquatic wildlife includes a variety of invertebrates, fishes, birds, mammals, reptiles, and amphibians associated with the stream, lake, and pond-marsh biotic communities.

Stream riffles and sand-bottom pools are characterized by caddisfly larvae, mayfly naiads, stonefly naiads, crayfish and snails. Fish characteristics of streams in this coal province include the plains minnow, longnose dace, flathead chub, goldeye, fathead minnow, river carpsucker, black bullhead, channel catfish, stonecat, plains topminnow, plains killfish, and white sucker (Baxter and Simon, 1970; Brown, 1971; Costello, 1964; Fish and Wildlife Service, 1952). Rainbow trout and brown trout are found in suitable larger streams. The shovelnose and pallid sturgeons, and the paddlefish survive in the Missouri River and some tributaries, but the shovelfish is considered a threatened species over parts of its range (Baxter and Simon, 1970). Other stream-associated wildlife include the tiger salamander, plains spadefoot toad, great plains toad, leopard frog, and snapping turtle. The belted kingfisher feeds on stream fish and nests in adjacent banks. Muskrats make burrows in the stream banks and feed on streamside vegetation. Mink patrol the streams for mustrat and fish Beaver feed on the aspen, willow, and cottonwoods along stream courses and in some localities build dams creating pools.

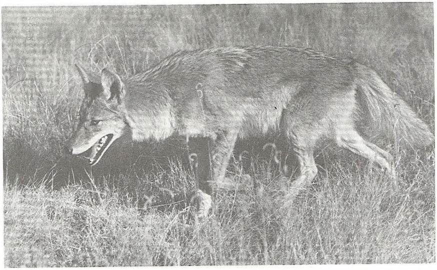
Lakes, defined as large, deep, thermally stratified bodies of water, are relatively few in the Northern Great Plains Province. Lake biotic communities are seen in lakes such as DeSmet in the Powder River Region, Fort Peck Reservoir bordering the Fort Union Region and Cherry Creek Reservoir in the Denver Region.

Lakes are closely knit ecosystems largely independent of the rest of the world, except for solar energy, inflowing water and mineral salts. The base of food chains is composed of detritus, bacteria, and phytoplankton (free-floating or barely mobile small animal organisms), small bottom organisms, and finally, fish and birds. Amphibians and reptiles do not commonly occur in lakes, except around the edge supporting aquatic vegetation, and here pond species occur. In this coal province, many fish mentioned above as found in streams are found in the lakes also. In addition, species more characteristic

Pronghorn antelope abound in the Northern Great Plains Coal Province.

of the lakes include yellow perch, largemouth bass, black crappie, and carp. In deeper, cooler lakes, rainbow trout are often planted and maintained by man. A number of birds commonly inhabit the lakes and subsist mainly on fish. Common mergansers, California gulls, bald eagles, white pelicans, and osprey are among them. Swallows skimming over the water consume great numbers of emerging midge flys and other insects.

Prairie potholes, small reservoirs, and stock ponds are common throughout most of the province. These support pond-marsh biotic communities and are generally quite productive. They differ from lakes in that they are usually smaller, more shallow, and have rooted vegetation over much of the bottom. Air-breathing aquatic insects and terrestrial forms occur in the surrounding marsh. Amphibians, reptiles, birds, and mammals are usually more numerous than in lakes. The aquatic and emergent vegetation common in the more permanent potholes and ponds support many kinds of insects, amphipods, mites, flatworms, protozoa, and snails. Two predominantly terrestrial orders of insects, the Coleoptera and Hemiptera, have invaded the pond community. The diving beetles, whirligig beetles, and water striders are conspicuous examples. Terrestrial insects found in pond-marsh vegetation are mainly those whose immature stages live submerged, such as mosquitoes and midges. Fish such as bullheads, suckers, and yellow perch are often abundant. The spadefoot toad and tiger salamander, mentioned as members of the stream communities, are also common in the pond communities.



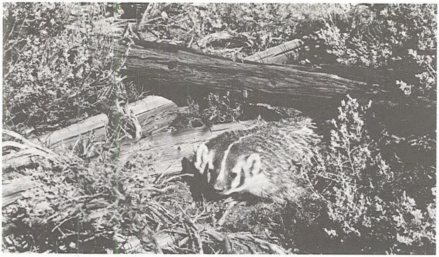
The Coyote is a familiar predator throughout the Great Plains.

Black-footed Ferret.

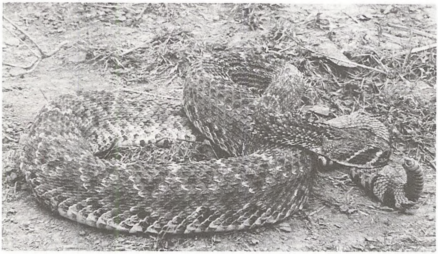
Probably, the most noticeable animals of the pond-marsh communities in this coal province are the waterfowl and shore birds. Part of the Fort Union Coal Region is within the famous duck-producing area known as the prairie pothole region. Potholes may average 30 per square mile (Linduska, 1964). The number, variety and quality of potholes available and the many kinds of plants and small animal life associated with them make the region a waterfowl-producing giant. In the drier portions of the coal province, manmade stock ponds and small reservoirs support pond-marsh communities and also produce large numbers of waterfowl (Linduska, 1964). Mallards, blue-winged teal, pintails, shovelers, gadwalls, American widgeons, and ruddy ducks, are common breeding species. Coots, avocets, killdeer, snipes, sandpipers, and grebes are characteristic water and shore birds. Many other waterfowl and water birds use the ponds and potholes during migration.

The muskrat is the most characteristic mammal of the pond-marsh community. Mink, a primary predator of the muskrat, are usually common where muskrats are plentiful. Red fox, raccoons, and skunks are frequent users of the pond-marsh communities.

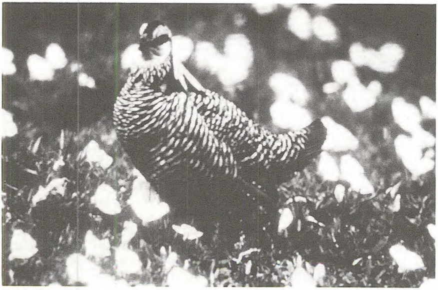
Threatened Species. Those wildlife species determined by the Secretary of the Interior to be threatened with extinction and named on a list published in the Federal Register are officially "endangered species." The species categorized as "threatened" in the Bureau of Sport Fisheries and Wildlife's 1973 publication, *Threatened Wildlife of the United States*, include all vertebrate species whose existence is considered threatened



Much of the Northern Great Plains Coal Province is Badger habitat.



Rattlesnake.



Prairie Chicken.

whether they are officially listed as "endangered" or not.

The black-footed ferret and American peregrine falcon are found within portions of the Northern Great Plains Coal Province. They are officially endangered species. Ferrets are closely associated with prairie dog towns as prairie dogs are their major food source. They are most apt to be found in the Fort Union, Powder River, and Denver Coal Regions, but may occur in isolated populations throughout the province. Very few nesting peregrine falcons are known to occur in this province, probably less than a half dozen pairs. Nests are usually found in coniferous forests or along major rivers. Extreme care is required to preserve them. The southern bald eagle, also "endangered," probably occurs in the Raton Mesa Coal Region as a winter resident or migrant.

Other species considered threatened that are found in this coal province include the Tule white-fronted goose, probably a migrant user of the prairie potholes; the prairie falcon, commonly a rimrock nester in the plains areas; the northern greater prairie chicken found in the grasslands of the Fort Union and Denver Coal Regions; and possibly the rare spotted bat.

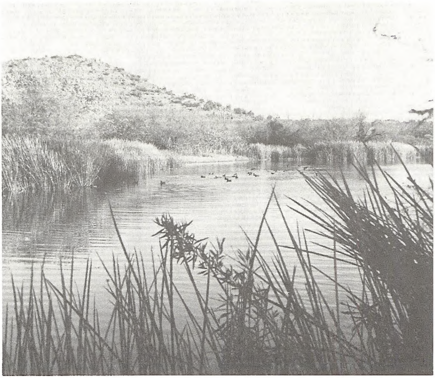
Some species while not endangered throughout their range, have remnant populations in danger of being eliminated in local areas. This has prompted state development of "rare and endangered" species lists. Wyoming's list includes such species as the shovelnose sturgeon, goldeye, sturgeon chub, kit fox, upland plover, and western smooth green snake, all of which occur within this coal province. Other States have, or are developing, similar lists.

Land Use

The Northern Great Plains Coal Province is primarily a vast expanse of rolling grasslands dissected by various major river systems. Much of the area remains in native vegetation. Extensive-type land uses dominate. Information from Missouri River Basin Investigations provide an idea of current land uses (Table 2-12). Lands administered by the Bureau of Land Management are in four subbasins including the Yellowstone River, Upper Missouri, Western Dakota tributaries, and Platte-

Niobrara. Pasture and range utilized by livestock and wildlife constitute the most extensive uses involving from 61 percent to 74 percent of the subbasins. Croplands, primarily dryland, are also significant, utilizing from 8 to 25 percent. Forests and woodlands cover from 5 to 14 percent of the subbasins. Other uses in order of magnitude are: recreation (up to 3 percent of the subbasins), urban and transportation (2 percent), fish and wildlife, military, mineral industry, and other.

Agriculture. Agriculture land uses including grazing of sheep and cattle and crop production are the most extensive uses involving 85 to 90 percent of the Northern Great Plains Coal Province. Grazing occurs on up to 74 percent of the subbasins. Rangelands are highly productive in comparison to many other Federally managed lands. Their average productivity is 6.5 acres per AUM. Cattle operations are dominant and oriented toward cow-calf or cow-calf-yearling production programs. Rangelands managed by the BLM and the Forest Service, as well as private holdings, are extensively grazed.



Much of the country of Montana and North Dakota is a breeding ground for millions of waterfowl.

Croplands are distributed throughout the province. Dryland farming is the most common method, but some farmers irrigate lands along the valleys where water is available. Livestock feeds and human food crops are both important. Major crops include wheat, barley, oats, and hay with some production of sugar beets, corn, and dry beans. In terms of value, production is split about evenly between livestock and crop production.

Timber Production. Forest and woodland vegetation covers from 5 to 14 percent of the land area within the various river subbasins. Timber and woodland types include pinon-juniper, ponderosa pine, Douglas-fir, Englemann spruce, and lodgepole pine. National resource lands have forests and woodlands on 5 percent of the area. Pinon and juniper is the dominant type of vegetation on national resource lands. Productivity of the forest and woodland area for wood products is moderate. The area provides habitat of vital importance to wildlife populations. Other significant uses include watershed protection, outdoor recreation, and domestic livestock grazing.

Watershed. The Northern Great Plains Coal Province is primarily within the Missouri River Basin. The Plains area provides runoff from zero to 5 in. annually. The condition of this watershed is of vital importance to water quality.

Studies of national resource lands in the Missouri River basin indicate relatively stable watershed conditions. Studies indicate that 64 percent is classified as having from no erosion to slight erosion, 29 percent slight to moderate erosion, and 7 percent moderate to severe erosion.

The Missouri Basin has 1,345,000 acre-feet of surface water depletion. Agriculture-related uses and loss to evaporation from storage facilities are the most significant sources of water depletion. BLM studies indicate that livestock and watershed improvement activities deplete 45,000 acre-feet or an estimated 3.3 percent of total depletion in the basin.

Mineral Industry. Mineral production in the province is an insignificant use of land in terms of percentage, however, in localized situations use for mineral production is significant. Minerals produced include coal, bentonite, gravel, other building materials, oil, gas, and gold. However, gold is not produced within the area where coal occurs. The extensive reserves of coal indicate that the mineral industry will be of greater significance in the future.

Urban and Transportation. The Great Plains Coal Province is sparsely populated but does make relatively significant use of land for urban and transportation uses. Data from Missouri River Basin studies indicate that up to 1 percent of the subbasins are used for these purposes.

Major urbanized areas with the bulk of residential, commercial, and industrial uses include Great Falls and Billings, Montana. Highways, railroads, pipelines, and powerlines form a transportation network.

Wild Horse and Burro Habitat. Wild horse and burro populations are not extensive in the Northern Great Plains Coal Province. Some isolated occurrences exist in Wyoming and Montana, but populations are scattered and limited in comparison to the situation in the Rocky Mountain area.

Canada Geese.

Recreational. Facilities in an organized sense are far less numerous east from the Rocky Mountains into the Northern Great Plains.

Extended remote areas of rolling countryside provide a degree of seclusion, and to some this is a very satisfying recreational experience. Federal and State facilities, however, are more sparse, and the recreationist must build his interest around available activities or be satisfied with a less formal camping and picnicking exposure.

Numerous historical features are found in this province, most notably the Lewis and Clark Trail and the Bozeman Trail. Also in this province is an old Travois Trail, thought by some historians to have been one of the migration trails from Asia. A portion is preserved near Heart Butte, Montana. Fort Rock, Crow, and Cheyenne Indian Reservations are also important to the tourist.

Most drainages support a substantial trout population for the fishing enthusiast. Pronghorn antelope hunting is particularly favorable throughout the Northern Great Plains.

Population Patterns and Considerations

The Northern Great Plains Coal Province is thinly occupied (less than 10 persons per square mile) and almost entirely rural in social orientation. Social attitudes and mores are basically conservative and marked by relatively slower rates of change than in other parts of rural America. New social norms and patterns are slow to be accepted, and there is a considerable reluctance to see radical social change. Ranching, dry farming, and irrigated agricultural land use has resulted in a sparse population. Towns are centers for commercial, governmental, and other services. They are widely separated along major transportation routes. Townspeople generally share many of the social attitudes of their country neighbors. Older, traditional pioneer social characteristics are prized, such as strong family ties and community social conformity, with somewhat paradoxical emphasis on individual self-sufficiency and personal initiative bordering on "rugged individualism."

The people of the province place high value on attachment to the land and its traditional uses. The more radical changes in social norms and acceptable standards of mid-20th century America have not significnatly affected the social fabric of the province. Pioneer social values and standards are much valued, and radical alteration of social patterns is not

Table 2-12
Land Uses in the Missouri River Basin, 1972

	Subbasins							
	Yellowstone River		Upper Missouri		Western Dakota Tributaries		Platte-Niobrara	
	(1,000 Acres)	(%)	(1,000 Acres)	(%)	(1,000 Acres)	(%)	(1,000 Acres)	(%)
Pasture and Range	33,628	74	33,252	61	35,253	71	39,671	62
Forest and Woodland	6,100	14	7,200	14	2,500	5	5,200	8
Cropland	3,400	8	10,700	20	9,300	19	15,600	25
Recreation	1,400	3	500	1	300	–	400	–
Urban and Transportation	200	–	1,200	2	900	2	1,200	2
Fish and Wildlife	50	–	100	–	100	–	200	–
Mineral Industry	10	–	3	–	3	–	3	–
Military	10	–	7	–	300	–	100	–
Other Agriculture	100	–	300	–	200	–	600	1
Water	300	–	700	–	500	1	700	1
Total	45,198		52,962		49,356		63,674	

Source: Bureau of Land Management, Missouri River Basin Study, Land Inventory of the Public Domain – A Summary – 1972

The grazing of cow-calf herds is a major land use in the Northern Great Plains Coal Province.

Croplands are distributed throughout the province. Dry land farming is the most common.

acceptable to most of the inhabitants of this coal province.

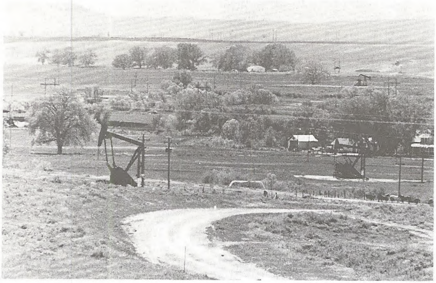
As a people, they are accustomed to wide horizons, vast expanses of space, and may require a broad, horizontally oriented environment for personal psychic well-being. They are adjusted to wide variations in temperature and radical weather changes and extremes. They are largely dependent on land and climate for their livelihood and take pride in making their living from a land and climate that is at times hostile and at other times bountiful. They are plainsmen, with the inherited social values of the 19th Century cattlemen and the tenacious dry-land homesteader.

This philosophy of life may be one reason for the introduction of the "Mansfield amendment" S.435, the Surface Mining Reclamation Act of 1973 (Congressional Record-Senate, 1973). That the philosophy may be altered when economic benefits accrue to an individual or private corporation is a possibility considering the fact that leases covering 430,398 acres of private land in Montana are now in existence (Northern Plains Resource Council, 1973).

Political. The people of the province are generally politically conservative. They are accustomed to making their own political decisions in local government and are in the main prone to be active participants in the political areas affecting their economic and social values. Denver is the largest urban center affecting the political climate of the province that feels a cohesiveness of self-interest transcending state political boundaries. Eastern Montana plainsmen are much more politically in harmony with their fellows in the western Dakotas and northeastern Wyoming than they are with mining-dominated western Montana. Many of these people are violently opposed to plans for extensive strip-mining and coal-electrical power generation being developed in their region. Much evidence of their opposition to coal development is seen in regional newspapers and such publications as *Montana Outdoors*. They do not wish to see radical change in their existing social, economic, and political way of life.

Economic. Economic patterns and attitudes are closely related to and interact with the prevailing social and political views. Ranching, small grain agriculture, and irrigated farming along the river valleys are the primary elements of the economy. Industrial plants exist only in supportive roles, such as the processing of sugar beets and are not themselves major elements. Towns are trade and transportation centers. Some coal has been mined in the past, but national interest in the coals of this province is of recent date. Oil and gas production in the Williston basin has had a marked impact on the economy of the Fort Union Region. Recreation and tourism have been important and are growing in economic importance, but not to the extent the mountain areas have experienced.

Ethnic. The Northern Plains Indians are the largest single ethnic group in the Northern Great Plains Coal Province. Actually, these Indians represent a variety of Indian tribes: Crow, Gros Ventre, Mandan, Arickara, Sioux, Chippewa-bee, Blackfeet, and Northern Cheyenne. They speak different languages and exhibit other physical differences, but all are native Ameri-



Oil and gas field near Glenrock, Wyoming.

One of the growing land uses in the Northern Great Plains Coal Province is coal mining. This mine is operated by the Knife River Coal Company near Beulah, North Dakota.

Land reclamation can be in the form of a lake for recreational purposes. This lake was formed from the Big Horn Mine No. 1 in Sheridan County, Wyoming.

cans. The Blackfeet, Ft. Belknap, Crow, Northern Cheyenne, Ft. Berth old, Pine Ridge, Rosebud, Ft. Peck, and Northern Cheyenne reservations are all underlain with coal, as are the lands adjacent to these reservations. Some of these people, such as the Crows in 1972, have consented to coal leasing. Others, such as the Northern Cheyenne in 1973, are violently opposed to coal development, which they view as a direct threat to their ethnic integrity. Due to insufficient data on the impacts of coal development there has been reluctance by all tribes to allow coal development subsequent to 1972.

Few Indians have been completely assimilated into the white culture in this coal province, and there has been discrimination against Indians based on ethnic and cultural attributes.

Cultural and Religious. People of this coal province are generally conservative in cultural and religious matters. The Indian inhabitants of the province are also culturally conservative, especially in ways that are involved with land use and occupation. Basically, man is part of the natural environment in the Indian view and derives much of his identity from interaction with the natural world about him. To the Indian, man is not set apart from the natural world, but rather is a component part of the world and should be in harmony with it. Opposition to coal development by the Northern Cheyenne in June, 1973, is partly based on fears that the familiar natural world they feel a part of will be despoiled and irrevocably altered by massive strip-mining of their reservation and the adjacent lands they feel a psychic attachment to.

Archeological and historic sites of national, regional, state, and local significance are located in this province on or adjacent to coal bearing lands. Sites and structures relative to the history of the early fur trade, exploration, settlement, and the Indian Wars are profusely scattered over the entire province. Some historical sites are protected as units of national, state, and local park systems; others are as yet unprotected, and of these many are situated in areas where Federal coal is located. Inventory of historical and archeological resources is in progress

The Northern Great Plains provide many hunting possibilities.

by Federal agencies, and many will ultimately be included on the list of National Historic Places maintained by the National Park Service. Historic sites, forts, and battlefields are a major tourist attraction in this coal province.

Human-Value Resources

Esthetic Values. Landforms within the Northern Great Plains Coal Province have a great similarity throughout. It is characterized by rounded, moulded slopes stretching as far as the eye can see, broken only by an occasional uplift or drainage system.

Line patterns are insignificant, occurring primarily in manmade features such as roads, power lines, or fences. In cultivated portions of the province, strong linear patterns are produced by rows of crops or the edges of cultivated fields.

In undisturbed grasslands, color and textural patterns are similar. Some variations exist, however, where native stands of grass have been converted to grain or cultivated pasture.

Lack of overall constrasts provides little in the way of a dominant element in the general sense, yet a pastoral scene with grazing livestock may produce a rather tranquil and pleasing mood. In addition, a viewer may be in a spot in which local elements produce a number of contrasts, especially near a drainage or topographical break.

Historic. The Northern Great Plains Coal Province, like the Rocky Mountain and other provinces, abounds in historic sites, ruins, trails, structures, and objects that are physical links with an evidence of historical heritage. Preservation, research, and development of these historical culture resources are vital to comprehension of the American past and present and may serve as indicators and guidelines for the future. Nationally, significant identifiable historic resources, such as Fort Union Trading Post, Theodore Roosevelt National Memorial Park, and Custer Battlefield National Monument are units of the national park system and administered and protected under Federal statutes and regulations. Other historic and cultural resources are included in state and county park systems. A great many smaller and less significant or well-known historic resources are scattered over the province on Federally administered lands. Inventory of these resources is currently underway by Federal agencies, but is far from complete. Some historic sites, such as the Battle of the Rosebud (June 17, 1876) and the Battle of Wolf Mountain (Jan. 9, 1877), may be affected by surface coal-mining operations. In addition to Indian War battle sites, many historic military posts, early ranching sites, fur trading posts, Indian village sites, transportation and communication historic sites, and others exist in considerable profusion in this coal province. Included are historic cultural resources related to:

- Early exploration by the Lewis and Clark and other expeditions.
- The history of such Indian tribes as the Blackfeet, Crow, Assiniboine, Sioux (many branches), Gros Ventre, Mandan, Arickara, Cheyenne, Arapaho, and Pawnee in their interactions with each other and confrontation with the white cultures.
- Military history is represented in the Powder River War of 1865, the Sioux Wars of 1862-1864, 1866-1868, and 1876-1881; and many smaller campaigns and expeditions still traceable on the land.
- The economic, social, and developmental history of the province includes the history of the fur trade of the plains, ranching development, exploitation of the buffalo, the farming frontier, transportation and communication development, and the early settlement of towns and communities.

Geologic. The Northern Great Plains Coal Province is characterized by rolling plains, tablelands, and isolated mountains. This is the area of the Upper Missouri River drainage. The most outstanding geologic features of human interest are the many dome mountains. An example is the Black Hills, an area 50 to 100 miles, formed by the intrusion of molten rock beneath the overlying sedimentary strata. This underground pressure forced the surface up in the form of a dome. This uplifting activity has been related to the creation of the Rocky Mountains. The Black Hills' long axis runs parallel to the Rocky Mountains indicating that the horizontal pressures which formed the Rockies were important in shaping the Black Hills dome. The intruding magma sometimes ruptured the covering strata, lifting them irregularly, as in the Mocassin Mountains in Montana. These overlying strata are sedimentary, and this is important for many other human-interest features of this province. The sedimentary limestones contain many spectacular caverns as Jewel Cave and Wind Cave National Monuments. The northern and eastern borders of the province were glaciated during the Pleistocene Age and show some features such as kettles, moraines, drumlins, and eskers of possible human interest.

Other human interest values are provided by Wyoming's Devil's Tower and the badlands of South Dakota.

This province, particularly in eastern Wyoming, is rich in paleontological values, which are stratigraphically found above the coal-bearing layers. It was this area in which the progenitor of today's modern horse was discovered, and here in the geologic past it flourished along with many other significant vertebrates. In some coal formations of the province, the time of the animals and of coal formation was concurrent. All vertebrate fossils are protected by the Antiquities Act of 1906.

Archeologic. As has been previously described for the Rocky Mountain Coal Province, the earliest dwellers of the plains are believed to have been the Paleo-Indians of the Big-Game Hunting Tradition. The aforementioned province description included cultural information for two of the cultural subareas in this province, the Northwestern and Central Plains subareas. The Northern Great Plains Coal Province contains elements of two other culture subareas, the Northwestern and the Middle Missouri subareas.

Approximately 4000 B.C. is the time given for the change from the Big-Game Hunting economy to the Plains Archaic which was a hunting-gathering, nomadic way of life. At about 4000 B.C. began a period of drier, warmer conditions that lasted about 1,000 years. During this time, accelerated erosion and arroyo cutting occurred and the times were so harsh that few or no humans lived in the western plains. At about 3000 B.C., archeological records indicate that the climate had ameliorated to the point of being able to support a hunting-gathering existence.

The northeastern and possibly the eastern portion of the Middle Missouri subareas yield sites in the 4000-3000 B.C. era, so it can be concluded that as harsh an enviornment did not pertain there. Plains Archaic sites are likely to be camps, caves, and bison kills. Some locations show refuse depth that indicates fairly steady, if seasonally intermittent, occupation.

The subsequent stage of cultural development, the Plains Village Tradition, is recorded in the northwestern part of the Central Plains and Northwestern Plains Cultural subareas only in attenuated and modified forms. Pottery entered the Northeastern and Middle Missouri subareas after 1 A.D., accompanied by the advent of agriculture. These and other additions entered from the eastern woodlands area, and the continued contact with the people to the east and southeast later brought the Plains Village Traditions' array of values.

Early in the Plains Village period, after 1000 A.D., the people lived in rectangular houses in settlements of 50 to 100 persons. The gardens (they were largely an agricultural people) would be located on the river bottoms, and the houses, on a bluff or ridge above. Houses of this period were of earth and timbers (earth lodges), rectangular in shape, and in the eastern part of the subarea tended to be semisubterranean while in the west, usually surface structures. Middle Missouri houses were larger and usually there were more houses in a village. They were usually fortified sites, also. Later, through drought, aggression, or both, many areas were abandoned and the people moved south to form very large village sites that were extensively fortified. Others moved to the north and northwest.

With the advent of the horse, many Plains Village Tradition people reverted to a mainly hunting style, while

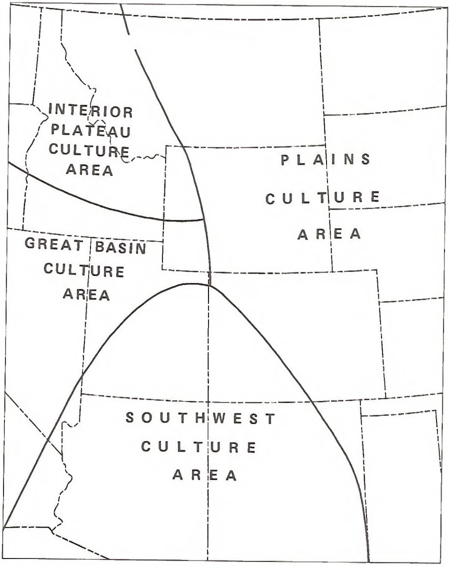


Figure 2-11. Prehistoric culture zones.

others, as did the ones which remained mostly agricultural, acted as go-between traders for European goods to other Indian groups. The Arikara, Mandan, and Hidatsa, and less, the Pawnee, remained agriculturalists well into the European contact era.

INTERIOR COAL PROVINCE

Geology

Of the nationwide total of 530 Federal coal leases 53 are located in this province. All are in Oklahoma.

The greater Interior Coal Province lies nearly entirely within the Central Lowlands and Interior Low Plateaus physiographic provinces' extensive areas of low relief in the interior of the continent to the east of the Great Plains (Fenneman, 1938, and Trumball, 1960). The area is underlain by Paleozoic sandstones, limestones, conglomerates, shales, and rocks the extend in nearly flat-lying formations from the Appalachian Plateaus across the central part of the United States to the Rocky Mountains. In the Central Lowlands these rocks crop out at the surface. They are buried beneath the younger sedimentary rocks of the Great Plains to the west and the Gulf Coastal Plains to the south. To the north, they overlap on the older Pre-Cambrian crystalline rocks of the Superior Uplands province.

The coal beds of the Interior coal province are Upper Carboniferous (Pennsylvanian) in age and mostly high-volatile bituminous in rank. They are generally of better quality than the coals of the west, but are also higher in sulfur content. The principal coal-bearing formations throughout most of the province are the Lower Pennsylvanian Pottsville and Allegheny Formations as defined in the Appalachian region or the age equivalents of those rocks. These age-equivalent rocks commonly carry local or regional names. They comprise a lower series that contains most of the coal, termed the Des Moines Group, and an upper series termed the Missouri Group.

Most of the Federal coal in the Interior Coal Province is in the southern part of the Western region, mostly in Oklahoma. In this area and in western Arkansas as well, mountain-building forces of the Ouachita disturbance sufficiently devolatilized the coal beds to raise their rank to low-volatile bituminous and, locally, semi-anthracite (Campbell, 1929). The coal is mostly of coking quality and is contained in rocks of the Hartshorne Sandstone and the McAlester Shale. The most important beds are the Lower Hartshorne, 2.5 to 6 ft in thickness, that lies near the middle of the Hartshorne Sandstone, the Upper Hartshorne, 1.75 to 5.5 ft thick, and the McAlester coal, 1.75 to 4 ft thick, that occurs in the McAlester Shale.

The coal-bearing rocks are folded into a series of eastward-and-northeastward-trending broad, flat synclines and tightly folded anticlines (Averitt, 1966).

Coal has been mined extensively in areas of moderate to low-dip (20° or less), but areas of steeply dipping coal beds have been mined only locally. A report by Trumball (1957) described the coal resources of Oklahoma and included a detailed classification of the resources.

Topography

The Interior Coal Province has a generally flat to rolling topography of gentle relief. There are some eroded mountains in eastern Oklahoma and western Arkansas known as the Ouachita and Boston Mountains. The maximum elevation is 2,800 ft above sea level. There are numerous scenic rolling hills such as the Ozarks in Missouri and Arkansas plus steep bluffs along many of the rivers and broken hills in southern Illinois, Indiana, and western Kentucky. The elevation of most of the area is less than 700 feet.

Climatology

The climate of the Interior Coal Province is characterized by hot humid summers and cold humid winters. The annual precipitation ranges from a low of 24 in. along the western and southwestern boundary to more than 56 in. in the Ouachita Mountains of western Arkansas. The majority of the area receives between 32 and 48 in. of precipitation per year. March, April, May, and June are the months with the highest precipitation. Parts of the area receive over 4 in. per month during this time. The rains come during the growing season. Fall rains in the Interior Coal Province may average over 2 in. per month. The humidity averages between 60 and 70 percent most of the year, with some portions having a higher average in the fall and winter.

Temperatures in the southern portion average above 40° in January, and above 80° in July. In the Northern portion, the temperatures in January average above 20° and above 70° in July. The mean annual freeze-free days range from 150 in the north to 210 in the southwest. The winds are typically out of the west and northwest in the winter and out of the south the rest of the year. This area is subject to many tornadoes every year.

Hydrology

Most of this province has abundant supplies of water. However, most industries and municipalities must treat surface waters and some of the ground water before it is used.

The hydrology of the province can be divided into the glaciated part and the unglaciated part. In the glaciated part of the province, most large surface-water supplies generally have less than 500 mg/1 dissolved solids, but may be high in sediment, iron or manganese content. The ground water obtained from river alluvium generally has a higher dissolved solids content than surface water, and locally may be very high in iron and manganese. Other groundwater sources in the glaciated area are only sufficient for small domestic and livestock needs, though glacial outwash and buried alluvial channels may yield moderate to large supplies in some areas.

In the unglaciated part of the interior province, surface water supplies are highly variable. In most areas underlain by coal, relatively thin beds of sandstone and shale cannot store and transmit large quantities of water. Therefore, during intense storm events, these areas experience rapid runoff and streams have high peak flows, while during dry periods discharges are very low. The quality of surface water ranges from low dissolved solids and high sediment concentrations during high flow periods to

high dissolved solids and low sediment content during low flows.

Ground-water supplies in the unglaciated part of the province can be obtained from river alluvium, shale, sandstone, limestone, and dolomite aquifers. The river alluvium generally yields moderate to large supplies of water of good quality. The shallow sandstone and limestone bedrock aquifers generally yield less than 25 gpm of medium to poor quality water. In some parts of the area wells over 1,000 feet deep penetrating Cambrian and Ordovician carbonate aquifers underlying the coal bearing strata will yield over 500 gpm of good to medium (less than 2,000 mg/l dissolved solids) quality water.

Soils

Some dominant soils within the Interior Coal Province are listed in Table 2-13 along with some characteristics, uses, and limitations. Specific examples for each soil such as the unified classiffication of the subsoils for engineering uses and hydrologic groups are given as well as general information. The listed soil series are not inclusive. They occur extensively, but they must be viewed as examples. A detailed on-site soil survey must be made before the total soil resource is known. More detailed information of the soil characteristics and limitations may be obtained from the soil survey reports listed in the selected references.

Descriptions of soil organisms in the Pacific Coast Coal Province also pertain here.

Vegetation

In the Interior Coal Province, Federal coal leases lie in the northern temperate portion of the grassland biome and in the deciduous forest biome. Oak trees and big bluestem grass occur in the western part of the area. Further east, blue stems, panic grasses, and Indian grass is interspersed between stands of oak and hickory. At the east end of the area, pine is mixed with oaks and hickories.

Wildlife

Federal coal in the Interior Coal Province is primarily in eastern Oklahoma. The fauna of this area consist primarily of deciduous forest edge species (Shelford, 1963). Oak-hickory forest, tallgrass prairie, and transitional zones make up the major habitat types of the Federal coal lands. Few mammalian species have large populations in the oak-hickory forests (Shelford, 1963). White-tail deer, raccoon, red fox, gray fox, eastern gray squirrel, fox squirrel, brush mouse, eastern woodrat, eastern cotton tail, striped skunk, and opossum are common mammals.

Representative birds are the tufted titmouse, red-eyed vireo, wood thrush, ovenbird, wild turkey, and bobwhite quail. The greater prairie chicken may be found in savannah types.

Waters of the area are generally highly productive. The Arkansas drainage reportedly contains 110 species of fish. Fishes are mostly warmwater species such as buffalo fishes, suchers, carp, catfishes, bullheads, yellow perch, bluegill, sunfishes, and crappies.

Amphibians and reptiles found in the Federal coal areas are the box turtle, spiny soft-shelled turtle, cricket frog, collared lizard, sixlined racerunner, ringnecked snake, rough green snake, kingsnake, gartersnake, and ground snake (Stebbins, 1966).

Invertebrates, which include insects, worms, snails, etc., are undoubtedly present in larger numbers and in a wider variety than other animals in this province. The scope of this statement and the inadequate available information and knowledge of invertebrate populations over such broad areas prevent meaningful discussion here.

Endangered species found in this coal province that may possibly be encountered on Federal coal lands here are shown in Appendix C.

Land Uses

Over 75 percent of the land area is used for some type of agriculture. Cropland comprises about 50 to 75 percent, pasture about 5 to 15 per-

Figure 2-12. Interior Province.

cent, and woodland about 15 to 30 percent of the agricultural area.

Coal is plentiful in the province, and some oil and gas exists. Some silver, lead, zinc, and iron occur within the tristate area of Arkansas–Missouri-Oklahoma.

Water use is dominated by industrial demands, including major portions for steam-electric power generators. Flooding may be expected once in every 2 to 5 years in parts of the area.

Population Patterns and Considerations

Southeastern Oklahoma Federal coal lands are located in a sparsely populated area in what was once the Chocktaw and Chickasaw Nations. Many inhabitants are part-time coal miners and farmers. The people could be classified as socially, economically, and politically conservative. Some are Indian or part Indian, but were long ago assimilated into the American culture.

Human-Value Resources

Esthetic Values Where Federal Coal Occurs. Federal coal is located primarily in eastern Oklahoma within the Western Region of the Interior Coal Province.

Gently rolling landforms are characteristic of the Osage plains where the principal coal deposits occur. Occasionally, uplifts provide interest and contrast within the area.

There are no heavily forested areas, consequently textural and color contrasts occur among scattered tree groupings and exposed soil or rock.

Agricultural activity and the influence of man add linear configurations to the landscape.

Historic. Much evidence of mid- and late 19th-century life styles is still present in Oklahoma, including structures and uses common to farming and rural life. Old roads and trails are still present, as are the small towns that have been there a century or more.

Geologic. The Federal coal lands of this province lie in Oklahoma and Arkansas. At the southern end of the Great Plains, this area is rolling and moderately hilly in the western portion and more hilly in the eastern part. The human-interest geological features of this area are the remnants of the Ouachita uplift, now tree covered and laced with many picturesque valleys and streams. Some caves, caverns, and hot springs exist in the area.

Archeologic. In the portion of the Interior Coal Province in which the Federal coal exists, the Big-Game Hunting Tradition was the earliest phase of human life. This was followed by an Archaic tradition at a time earlier than that area to the North.

Table 2-13

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Interior Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Crete	Nebraska (USDA, 1969)	CH	9-12	–	0-5	row crops, hay & pasture, short & reed grasses	range, farming
Limitations – Moderate erosion hazard, high in fertility, high shrink potential.							
Tillman	Texas (USDA, 1964)	CL CH	9-12	–	1-3	short grasses, small grains	range, cultivated crops
Limitations – High natural fertility, droughty, slight erosion hazard.							
Badland	Texas (USDA, 1964)	–	–	D	2-12 20-75	some short grass	–
Limitations – This land supports little vegetation. It is thoroughly dissected by large gullies and has bald ridges and knobs, severe erosion hazard.							
Post	Oklahoma (USDA, 1967)	ML or CL	6-9	C	nearly level	small grains, hay, orchards, pasture	farming
Limitations – Flood plain, calcareous substratum, thick surface layer.							
Richfield	Kansas (USDA, 1965)	CL or CH	9-12	C	0-3	small grains, native grasses	dry farming, range
Limitations – Table land, well drained, susceptible to wind and water erosion, natural fertility is high.							
Miami	Illinois	ML	9-12	B	2-35	crops, pasture forest	farming
Limitations – Erosion hazard is moderate to severe, compaction hazard is severe.							

This tradition was later heavily influenced by the Eastern Archaic and by the Desert Tradition from the West. This area apparently was on the fringe of most of the neighboring culture areas and in later Archaic times was closer to the Edwards Plateau Tradition of present-day northern Texas. Later, the heavily agricultural influence of the Caddo (a subtradition of the temple mound-building Mississippian Culture) brought newer concepts of government, religion, and material culture. As a part of the Southern Plains Subarea, the people shared in the Plains Village Tradition characteristics of large communities, some fortified sites, and an agriculture-based economy. At historic contact times, the area had elements of the surrounding cultures in its population; the Commanche to the west, Wichita in the north, Tonkawa to the south, and the Caddo-Mississippian Tradition in the east.

Archeological remains will continue to be associated with agricultural areas on the river bottoms with village sites on the bluffs or ridges above, camp sites, and tool chipping sites but fewer kill sites. Cave sites will be more valuable and significant.

GULF COAL PROVINCE

Nationwide there are 530 Federal coal leases. None are located in this province.

Geology

The Coastal Plain Physiographic Province encompasses the Texas and Mississippi coal regions of the Gulf Coal Province (Fenneman, 1938 & Trumball, 1960). The area is an extensive lowland, composed for the most part of unconsolidated beds of detrital sediments and limestones that dip gently seaward. Outcrop bands are successively older inland.

Coal deposits in the province are mostly lignite and are contained in rocks of the Yegua Formation and the Wilcox and Jackson Groups of Eocene age. Bituminous coal is contained in rocks of the Olmos Formation of Late Cretaceous age that crop out in a small district at Eagle Pass, Tex. near the Mexican border. Deposits of cannel coal of Eocene age have been reported in the Mount Selman Formation at the Santo Thomas field about 50 miles southeast of Eagle Pass (Mapel, 1967).

Beds of the lignite field range in thickness from a few inches to 25 ft, and are contained in soft sandstones and clays. The rocks containing the lignite dip gently toward the Gulf and are covered beneath younger rocks to the south and east, but it is unlikely that the lignite extends very far in this direction because the beds were formed in relatively narrow belts marginal to the migrating shoreline. The lignite is locally used in large volumes as an industrial fuel for power generation and in turn for aluminum ore reduction (Keystone Coal Catalogs, 1972).

Topography

The topography of the Gulf Coal Province is that of coastal plains, minimal relief, and a significant area of coastal flats. The Mississippi River has meandered over a large portion of the middle of this province leaving a large, nearly level, alluvial plain. There are no mountains in the province. Approximately 80 percent of the area is gently sloping to nearly level and the elevation is less than 300 ft. There are large numbers of marshes and swamps.

Climatology

The climate of the Gulf Coal Province has moderate winters with very hot, high-humidity summers. Precipitation varies from 20 in. in southwest Texas to more than 65 in. in southern Louisiana per year. Most of the area receives 50 in. per year, nearly all in the form of rain. Most of the area receives more than 4 in. per month except in August, September, and October, when the average is slightly lower. The coastal parts of Louisiana, Alabama, Mississippi, and Florida may receive more than 8 in. of rain on the average.

The tempterature of the northern portion averages 40° in January and 50° in the southern portion. The temperatures average above 80° for the whole area in July. The northern portion averages more than 210 freeze-free days per year and more than 270 freeze-free days per year near the coast. The Mississippi River delta has more than 300 days without freezing temperatures per year. The winds are varied in the winter, typically out of the south in the spring and summer and usually from the northeast in the fall. Hurricanes may be an occasional threat in late summer.

Hydrology

The Gulf Coast Hydrology Province is well endowed with both surface and ground-water supplies. Surface streams generally are perennial and have good quality throughout the year. Except for the southwestern part of Texas,

Coal strip mining in eastern Kansas.

droughts are uncommon. Sediment content of surface waters is generally low, except during high flows.

The area contains abundant supplies of good-quality ground water. Yields of over 1,000 gpm can be obtained from alluvial wells or bedrock wells over much of the area. Many high capacity wells over 1,000 ft deep yield water with less than 500 mg/l dissolved solids. The major ions in the potable ground waters are calcium, sodium, and bicarbonate.

Soils

Some dominant soils within the Gulf Province are listed in Table 2-14 with some characteristics, uses, and limitations. Specific items for each soil such as the unified classification of the subsoils for engineering uses and hydrologic groups are given as well as general information. Thus, the information may be used for engineers, hydrologists, and soil scientists as well as the general public to gain some knowledge of the soils. The listed soil series are not inclusive and must be viewed as examples. More detailed information of the soils characteristics and limitations may be obtained from the soil survey reports listed in the selected references.

Vegetation and Wildlife

Lignite-bearing lands of the Gulf Coal Province are found mostly within the oak-hickory and oak-hickory-pine communities of the deciduous forest biome. Some southern grassland and mesquite savannah habitats are also found in the coal regions. Characteristics of the wildlife fauna in these areas are quite similar to those described for the Federal coal lands of the Interior Coal Province.

Some of the conspicuous wildlife species occuring in the Texas region of the Gulf Coal Province which are not typical of the lands underlain by Federal coal in the Interior Province are as follows:

Mammals
- Mexican free-tail bat
- Mexican ground squirrel
- Peccary
- Ringtail
- Hognose skunk
- Red wolf

Texas coastal prairie near the Gulf of Mexico.

Birds
- Roadrunner
- Scaled quail
- Attwaters prairie chicken

Amphibians and Reptiles
- Texas toad
- Texas blind snake
- Western diamondback rattlesnake

Endangered species which are found in this coal province can be determined from Appendix C. Since there is very little Federal coal in this province and no current Federal coal leases, few species are likely to be involved.

Land Uses

Most of the land is devoted to agriculture or forestry. Lignite is scattered in the northern portion of the province, while oil and gas can be found throughout. Sulfur and salt are produced in Louisiana and Texas.

Water use is dominated by industrial processes. Flooding may be expected once every 5 to 10 years in parts of the area.

Population Patterns

Population patterns in this province are very complicated; ranging from sparsely occupied rural areas to highly industrialized centers such as New Orleans. Any Federal coal leasing in this province resulting in mining will require a case-by-case study to assess human environment and impacts likely to derive from Federal coal operations.

Ethnic and cultural or religious factors in this province include the presence of sizeable French-Creole and black populations.

Human-Value Resources

Esthetic. In the Gulf Coal Province, lignite occurs in an arc from eastern Texas to western Tennessee and south-central Alabama. This area is characterized by pine-hardwood forests interspersed with farms. Topography is gentle, with streams and winding roads traversing the varied landscape.

Esthetic interest centers mainly the variety of the terrain, vegetative cover, and human influences, which are typical of the South.

Historic A wide variety of historic and cultural sites are present in this province. East Texas, Arkanasas, and Louisiana contain many sites related to early Spanish and French exploration and settlement, Texas settlement and independence, and the Civil War. Alabama and western Florida also contain historic and land resources related to early Spanish, French, British, and American activites, the War of 1812, and the Civil War. Fort Smith National Mounment, Arkansas Post, and Chalmette Battlefield are examples of his-

Table 2-14

Some Characteristics, Uses and Limitations of Dominant Soils Occurring in the Gulf Coal Provinces

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Reeves	Texas (USDA, 1969)	CL	3-6	C	level to undulating	desert shrub, salt tolerant grasses	range
Limitations – Salinity, high corrosion potential, calcareous outwash, gypsum in the subsoil.							
Brewster	Texas (USDA, 1969)	GC or GM	0-3	D	gently undulating to steep	short grasses, mid grasses, desert shrub	range, recreation, wildlife
Limitations – Bedrock within 20 in., stoniness.							
Goliad	Texas (USDA, 1973)	CL	3-6	C	level to undulating	short & mid grasses	range crops, wildlife
Limitations – High shrink-swell potential, severe building foundations problems, high corrosion potential, shallow to moderate depths to caliche.							
Ector	Texas (USDA, 1969)	CL	0-3	D	nearly level	short & mid grasses	range crops, wildlife, recreation
Limitations – Bedrock or cemented caliche within 80-in. depth, stoniness, moderate shrink-swell potential, severe erosion hazard.							
Victoria	Texas (USDA, 1965b)	CH	9-12	D	nearly level	cotton, sorghum, onions	cultivated crops
Limitations – Very high shrink-swell potential, cracks when dry, ponding occurs in depressions, calcareous clays.							
Orelia	Texas (USDA, 1965b)	CL	3-6	D	nearly level	cotton, grain, sorghum	cultivated crops
Limitations – Wind blows sandy soils with a hardpan in the subsoil, hardpan slows surface drainage, calcareous substratum.							
Oil Waste Land	Texas (USDA, 1965b)	–	–	–			
Limitations – This land has been damaged by oil, salt water, mud, or other byproducts of oil fields to such extent that its productivity has been seriously reduced or destroyed. For more than 25 years, some of this land has been covered by sterile mud, slush, salt water and oil to a depth of 1 to 4 ft. and it is still bare of vegetation. Some areas have been reclaimed.							
Olivier	Louisiana (USDA, 1965a)	CL	3-6	B	nearly level	pine & hardwood forest	pasture, urban use, wood crops
Limitations – Somewhat poorly drained, slowly permeable soils, severe erosion hazard.							
Sharkey	Louisiana	CH	9-12	D	nearly level	mixed hardwood forest, perennial grasses & legumes	cultivated crops, wood crops, pasture and hay
Limitations – Floodplain, difficult to work because of moisture content, cracks when dry, some areas subject to flooding.							

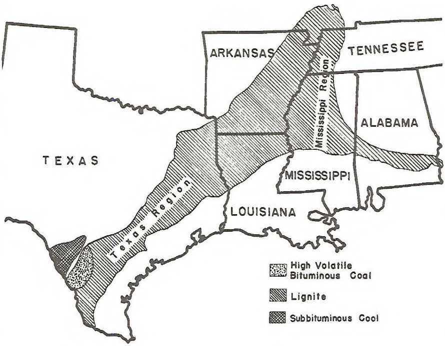


Figure 2-13. Gulf Province.

toric sites. San Jacinto State Park in Texas preserves the site of the climatic battle in the Texas War for Independence, and areas along the Rio Grande River include camp and battle sites of the Mexican War.

Geologic. The Gulf Coal Province is topographically a low, flat plain near the coast. Farther inland, the land becomes differentially hilly with broad valleys between hill systems. Rivers and streams comprise the most obvious geological features. These waterways' sedimentary and erosive qualities are responsible for the formation of the picturesque Oxbow Lakes, which become bayous with their luxuriant vegetation. The Mississippi River flows into the sea in this province forming an extensive birds's-foot delta.

The underlying rock of most of this area is sedimentary. This has resulted in many small caves and caverns through solution by the percolation of surface water downward. Southwest central Texas in particular has large caves with human-interest value. Many large springs and artesian features also attract human interest. Along the coast there exist many cenotes with their characteristic pools of water fed by an underground water source. Cenotes and caves are not in the same area as lignite deposists.

Archeologic. The Gulf Coast Coal Province is marginal to the area of the Big-Game Hunting Tradition, though it supported considerable Archaic exploitation throughout its range. From the west, the influence was primarily from the Desert Tradition, and in the east, the Woodland Tradition. Some areas, such as the Gulf Coast area, had been essentially Archaic style human exploitation at contact times.

On the lower Mississippi and along its tributaries, later Meso-American influences gave birth to the Mississippi Tradition with its characteristic Temple Mounds, large concentration of population, and a dominantly agricultural subsistence. While this was in the process of developing, the Woodland variant culture to the east was declining, to be replaced by Mississippian influence. Historic and protohistoric tribes in the province were the Karankawa, Atakapa, Tonkawa, Caddo, Quapaw, Tunica Choctaw, Apalachee, Natchez, and Chitimacha. Archeologic remains will be areas of mounds in flat areas, campsites, and habitational sites on ridges and bluffs.

EASTERN COAL PROVINCE

Of the nationwide total of 530 Federal coal leases, 3 are in this province.

Geology

The Valley and Ridge and the Appalachian Plateau physiographic provinces encompass nearly the entire area underlain by coal-bearing rocks of the Eastern Coal Province, (Fenneman, 1938 and Trumball, 1960). The rocks in these provinces form a series of sandstones, shales, limestones, conglomerates, and beds of coal that comprise the Appalachian basin. In the Valley and Ridge province along the eastern side of the basin, these rocks have been greatly disturbed by folding and faulting. On the western side in the Appalachian Plateaus province, the rocks with broad open folds are nearly flat and dip gently to the west.

The Appalachian coal region extends uninterrupted about 800 miles from northern Pennsylvania to western Alabama and across parts of Pennsylvania and Ohio at its widest part, (Arndt, Averitt, Dowd, Frendzel, and Gallo, 1968). The region is defined by outcrops of coal-bearing rocks of the Pennsylvanian, Monogahela, Conemaugh, Allegheny, and Pottsville Formations (used locally as group names). Along the eastern margin, these rocks are folded into several hundred small subsidiary anticlines and synclines, and locally some of these structures are separated from the main part of the region. On the east edge, beds dip very steeply locally, but moderate dips of about 20° are more characteristic. To the west, the beds dip less steeply until near the western edge, where they are nearly flat. The Pennsylvania Anthracite region is characterized by steeply dipping folded faulted beds, and overturned beds are common. These variations in structure are accompanied by parallel variations in rank of coal. The coal on the west edge of the Appalachian coal basin is high-volatile bituminous in rank. Along the highly deformed eastern edge, the rank of the coal is locally medium to low-volatile bituminous and ranges as high as anthracite in the intensely folded Anthracite region to the east.

The Appalachian region has yielded about 23 billion tons of coal from the beginning of the mining up to 1965. Of that total, roughly a third was produced from the Pittsburgh coal bed, which lies at the base of the

Monongahela Formation. This coal bed has been described as the most valuable mineral deposit in the United States and perhaps in the world (Ashley, 1938). This is only one of the several famous and productive coal beds in the region. The number of coal beds in the region thick enough to be mined or used in resource estimates ranges from 19 in Pennsylvania to 62 in West Virginia, with as many as 117 beds having been individually named and described. Even after such tremendous production from this single region, remaining coal reserves under 0 to 1,000 ft of overburden still total 110 billion tons (as of Jan. 1, 1974, Table 11).

Topography

The topography of the Eastern Coal Province is mountainous. The area essentially includes that area covered by the Appalachian Mountains. Here the extensive areas of bituminous coal are found in the Appalachian Plateau geologic province rather than in the Ridge and Valley Province, where the mountains are oriented northeasterly and southwesterly with numerous ridges, gaps, and escarpments paralleling the mountain structure. Folds, faults, and steeply dipping formations are common. Few of the peaks exceed 5,000 ft, but the area demonstrates relatively rough topography caused by well developed drainage systems.

Climatology

The Eastern Coal Province has hot humid summers and moderate to cold humid winters. The precipitation ranges from about 32 in. in the far north to more than 60 in. in the southeast. Most of the area receives between 40 and 50 in. of precipitation per year. The fall and winter have the least precipitation, and the spring and summer have the most. There is adequate moisture during the growing season without irrigation.

The temperatures in the north average between 20° and 30° in January, and usually above 70° in July, except for some of the higher mountains. In the south, the temperatures average about 40° in January, up to 80° in July. The northern mountainous areas have a mean annual freeze-free period of 120 days. In the south, this freeze-free period exceeds 210 days. The winds are typically out of the west in the winter, the southwest in the spring and summer, and vary in the fall. Occasional hurricanes cross this area in the late summer or early fall.

Hydrology

Eastern Province. The Eastern Coal Province has abundant surface water supplies. Most of the area has readily accessible surface water supplies. However, industrial and municipal pollution of surface waters is widespread, and two-thirds of the nation's acid mine drainage problems occur in the province. The quality of surface waters is complex. Most of the unpolluted streams have good-quality water, but municipal and industrial pollutants produce complex chemistry in many streams so affected. The sediment content of streams is highly variable in this area, with many disturbed areas contributing large amounts of sediment to streams during storms.

Ground-water supplies in the province can be obtained from river alluvium and bedrock aquifers. Medium to large supplies (100 to 1,000 gpm) of ground water can be obtained from alluvial wells. Generally, the water is of good quality. Bedrock aquifers of sandstone and limestone generally yield small supplies of good-quality water. In areas that have undergone extensive coal mining, ground water supplies may be polluted.

Soils

Some dominant soils within the Eastern Coal Province are listed in Table 2-15. Some characteristics, uses, and limitations are given for each of the listed soil series. Specific items for each soil such as the unified classification of the subsoils for engineering

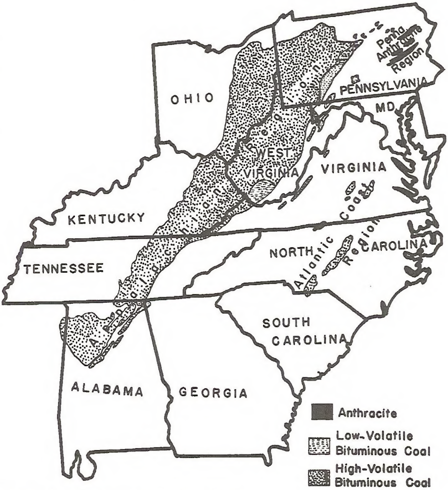


Figure 2-14. Eastern Province Occurrence of Coal.

uses and hydrologic groups are given as well as general information. Thus, the information may be used by engineers, hydrologists, and soil scientists as well as the general public to gain some knowledge of the soils. The listed soil series are not inclusive and they must be viewed as examples. A detailed, on-site soil survey must be made before the total soils resource is know. More detailed information of the soils characteristics and limitations may be obtained from the soil survey reports listed in the selected references.

Descriptions of soil organisms in the Pacific Coast Coal Province also pertain here.

Vegetation

The Eastern Coal Province is within the deciduous forest biome, primarily along the Appalachian Mountains. There is considerable range in vegetative types within the province. Oaks, hickories, cherries, and maples are prevalent hardwood species, intermingled with shortleaf, loblolly, Virginia, and northern balsam fir, and some other conifers.

Natural understories include a wide variety of shrubs, forbs, and grasses. Farmlands support a wide variety of crops including corn, small grains, cotton, tobacco, and pasture.

Federal coal is so widely dispersed and of such limited acreage that specific vegetative descriptions will be necessary to relate ground cover to Federal coal occurrence.

Wildlife

The limited Federal coal reserves of the Eastern Coal Province are found in regions where major plant associations are maple-beech-birch and oak-hickory forests, with a variety of wetland habitats included. These habitats naturally support wildlife species characteristic of the deciduous forest biome. The Federal coal reserves and existing leases are in small and scattered tracts within these broad communities. Local influences may cause significant deviations from the expected species composition on a particular Federal tract. A more detailed and specific description of the wildlife community would be made on specific tracts should leasing action be contemplated.

Nuts and fleshy fruits produced in the deciduous forest provide a large variety of food for wildlife. Animals such as the gray squirrel and eastern chipmunk often vary greatly in number from year to year, depending upon the abundance of nuts and seeds. Important mammals in the coal province include the white-tail deer, the eastern mole, black bear, gray fox, red fox, bobcat, raccoon, gray and fox squirrels, New England cottontail, short-tail shrew, opossum, southern flying squirrel, and white-footed mouse (Kendeigh, 1961; Burt and Grossenheider, 1964). In the southern oak-hickory part of the province, populations of mammalian species tend to be low.

Breeding birds in the maple-beech-birch association include the veery solitary vireo, black-throated blue warbler, blackburnian warbler, rose-breasted gosbeak, and wild turkey (Shelford, 1963). Typical snakes in this association were the eastern garter snake, red-bellied snake, milk snake, and eastern ringneck snake.

In the oak-hickory association, wild turkeys utilize the fruits of all the common deciduous forest trees, shrubs, and vines, with acorns being favored. A variety of typical deciduous forest birds are present. Copperheads, coral snakes, rough green snakes, rat snakes, coachwhips, and speckled king-snakes are reported forest snakes. The slimy salamander is the only salamander found regularly in the oak-hickory forest (Shelford, 1963).

Land Uses

Most of the land in the Eastern Coal Province is devoted to cropland, pasture, and forestry.

Coal, oil, and gas are found within the province. Iron, zinc, and cooper deposits are among the important minerals in the province. Water use is dominated by industrial demands. Floods can be expected once in every 5 to 10 years in parts of the area.

Population Patterns and Considerations

The Eastern Coal Province is a very large area with many different population variables. Federal coal occurs only in small parts of the Appalachian region, this description covers only the areas affected.

Social. In the Appalachian region, where coal occurs the people generally are socially conservative and courteous to strangers. Lack of contact with other areas and populations has resulted in these people's slow acceptance of change. Their isolation is a factor in this expressed reluctance. This same isolation has resulted in the development in them of their attitudes of independence and self-sufficiency. Isolation has resulted in intermarriage and the resulting kinship ties have usually served to bind the communities together more closely.

Political. The area's expressed conservatism, isolation, and history have resulted in a unique, insular outlook. Originally settled by landless latecomers to the New World, the land was fought for and cleared for agriculture by these early frontiersmen. These pioneers farmed the hollows and valleys and developed an ethic of self-reliance and a recognition of the values and responsibility of personal liberties evident today in their political outlook. This area provided men such as Davy Crockett to the early 19th-century expansion movement, and the area has remained development oriented. As expansion passed to the West, many remaining Appalachian inhabitants retained 19th century cultural values. Later, coal in their area was commerically developed, and the subsistence farmers accepted it, as a benefit to their way of life that had been bypassed by later national development. Within recent decades many of these values have been changing.

Economic. European settlement of this coal province was based on a hunting and subsistence farming style of life which persists today. The area is the nation's leading producer of coal, and most coal for export is Appalachian. The superposition of highly industrially oriented coal-extraction economy on a previously rural situation has left the inhabitants with a need for the material comforts that coal mining can bring them while they continue traditional life styles. The two are often mutually exclusive and the coal extraction efforts usually succeed, leaving the local peoples with the

Table 2-15

Some Characteristics, Uses, and Limitations of Dominant Soils Occurring in the Eastern Coal Province

Soil Name	Location	Unified Classification	Available Water Capacity (Inches)	Hydrologic Group	Relief (%)	Vegetation	Major Use
Miami #3	Ohio (USDA, 1962)	ML	9-12	B	gentle to steep	crops, pasture and forest	farming
Limitations – Erosion hazard is moderate to severe; compaction hazard is severe.							
Mardin #2	New York (USDA, 1970b)	ML or SM	3-6	D	sloping to steep	crops, pasture, and forest	farming
Limitations – Fragipan at 18 to 22 in., subject to sloughing and seepage above pan, high water table.							
Appling #5	North Carolina (USDA, 1970c)	ML & CL	3-6	D	gently to strongly sloping	crops, pasture and forest	farming and forestry
Limitations – Well-drained, natural fertility low, shrink-swell pot, severe erosion hazard.							
Wegram #5	North Carolina (USDA, 1970c)	CL & SC	3-6	A	nearly level to sloping	crops, pasture and forest	farming and forestry
Limitations – Somewhat excessively drained, low natural fertility, low stability.							
Madison	Georgia (USDA, 1971)	CL, MH	3-6	B	gentle to moderately steep	pine and deciduous forest	farming and forestry
Limitations – Moderate to high shrink-swell potential, gravelly surface soil, natural fertility is low, erosion hazard is moderate.							
Tallapoosa #6	Georgia (USDA, 1971)	ML, CL, SM	3-6	C	gently to moderately steep	deciduous forests	forestry
Limitations – Shallow, well-drained, natural fertility is low, rocky subsoil, severe erosion hazard.							
Chester	Pennsylvania (USDA, 1970a)	ML, CL	9-12	B	gently to steeply sloping	grain, pasture, and deciduous forests	farming and forestry
Limitations – Well-drained, very stony profile, severe erosion hazard.							
Lewisberry #7	Pennsylvania (USDA, 1970a)	SM, GM	6-9	B	gently to steeply sloping	grain, pasture and deciduous forests	farming and forestry
Limitations – Well-drained, gravelly to very stony profile, severe erosion hazard.							

negative values of a debased environment while they have shared few of the benefits. The province's inhabitants do not all want the mines, yet they feel they cannot do without them. Those who don't participate in coal mining frequently receive few of the ancillary economic benefits, leaving them, as one man said, "Too proud to take welfare and too poor to do without it." Recently income has improved considerably with miners earning $42 to $46 a day, although home improvement activity is at a minimum. Employment opportunities at the mines has been excellent for those seeking employment. Most homes have radio and television sets and many are driving late model cars and trucks.

Ethnic, Cultural and Religious The "mountain folk" residents of the coal fields constitute a distinct culture. They have been isolated from the development of the nation and they have remained more as their forebears were than the rest of the nation is today. Other than materially and superficially, the changes that have molded the nation have passed these people by leaving them with their distinct music forms, philosophies, religious expressions, speech patterns, values systems, and general outlook on life and the world. Though outwardly they appear as part of the dominant Anglo majority, within this culture they constitute a minority.

Human-Value Resources

Easthetic Values Where Federal Coal Occurs. A large coastal plain in the east with gently rolling hills and some mountainous areas in the western section are characteristics of the land forms within this province.

There are seasonal color contrasts which greatly contributes to the interest within this province. Various green shades predominate when in full leaf changing to brilliant shades of fall colors. In winter, the trunks of individual trees are apparent until obscured by new growth in spring.

Historic. Many vestiges of pioneer mountain life still remain in this province: log cabins and farm structures, mills, and other historic buildings and sites. Many life styles and attitudes have changed little in almost 200 years. Some areas contain sites related not only to early settlement, but also Indian conflicts of long ago and the American Civil War.

Geologic. The Appalachian Mountains are the Nation's oldest and most eroded. These mountains are generally low compared to the more recent Rocky Mountains. The Appalachians are characterized by steep slopes and a generally rugged terrain underlain by folded sedimentary rocks. Many of the Nation's most interesting and unique caverns exist in this area and speleological interest is continually growing in that area by interest from close urban areas. No geysers and few hot springs of great human-interest value occur. Due to the scenic value of these geologic features many hiking trails have been constructed throughout the area.

Archeologic. Archeologically this area lies in the Eastern Woodlands area of prehistoric use. The Big-Game Hunting Tradition was in this area early, perhaps in some places earlier than in the western plains. This later became the Eastern Archaic Tradition, with the appearance of many outside influences. The Eastern Archaic was notable for the early introduction of pottery and the development of agri-

The prehistoric inhabitants of this area gravitated to those areas that provided shelter, water, fuel, and were close to game and arable fields. While they may have utilized the hills and mountains for hunting and probably crossed them on trading and migration travels, the main habitational features are found on level land in the valleys. The area was not heavily or uniformly populated and the sites will not usually be in the same place as the deposits of coal, but can be affected by development and mining nonetheless.

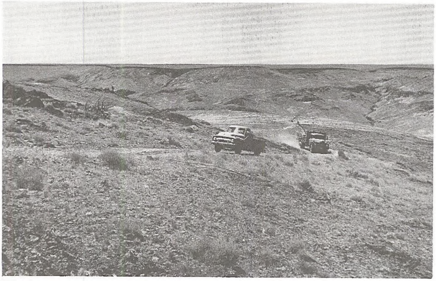
culture. Subsequent to this came the advanced cultures of the Woodlands Tradition. These people, the Hopewell, Adena, Copena, and their variants, were also known as the Mound Builders and were later replaced by elements of the Mississippian Tradition from the west. The Mississippians did not cover the same original territories as the Woodland Tradition, but their influences were felt by the people that lived at that time. The historic and protohistoric tribes in this province were the Chickasaw, Creek, Yucchi, Cherokee, and the Shawnee.

Chapter Three

Environmental Impacts

1. Environmental Impacts

Immediate impacts of ORV travel are to the surface where low-growing vegetation is injured or destroyed.



Vehicles traveling on undedicated roads scar the landscape.

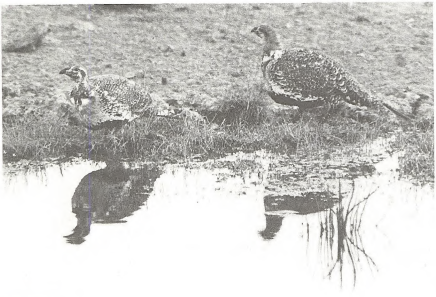
How Federal coal leasing is handled was explained in Chapter 1. Exploration, development, production, coal beneficiation, site rehabilitation and other actions are all part of a Federal coal leasing program. Details concerning the potential impact of these actions on the environment are included in this section. Possible secondary impacts which are also important aspects of the coal program will be covered to an extent in this report. As such this section does not identify impacts, per se, but rather the threats that could arise.

The Federal coal program normally begins with issuance of prospecting permits in areas of undetermined coal resources or by competitive leasing in known coal leasing areas.

There is some effect on the environment before issuance of a prospecting permit or lease. Companies or individuals interested in a particular potential coal area normally conduct air and field reconnaissance before definite interest in exploring a deposit can be established. The impact of low-level air reconnaissance flights is minor. Some noise pollution and limited disturbance of wildlife and domestic livestock is inevitable.

Issuance of a Federal coal lease has not always resulted in a measurable impact on the environment. A large number of leases exist today that have never become active coal-mining operations. Greater demand for coal may encourage production. In the future, coal provinces of the United States,

Attwater's prairie chicken.



Sage grouse.

except the Gulf Coal Province. The major provinces with leasable coal resources are the Northern Great Plains, Rocky Mountains, and Pacific Coast, which includes Alaska. The greatest number of existing leases are in the Rocky Mountain Province. The location of the Northern Great Plains Province with respect to potential markets and the abundance of easily recoverable coal suggests that it will receive major interest for leasing. Interest in Federal coal lands in the Pacific Coast Province will be centered in Alaska where large deposits occur.

Environmental impacts that are unique to specific provinces will be discussed separately under the heading "Unique to certain provinces."

IMPACTS COMMON TO ALL COAL PROVINCES

Off-Road Vehicle Travel

Several aspects of coal development, including field reconnaissance, exploration, and development, can involve travel over terrain without road construction. Several types of specialized equipment for off-road vehicle (ORV) travel are available.

Impacts of various ORVs differ. "Swamp buggies" and light weight tracked vehicles have lesser impacts than "jeeps" or heavy "caterpillars."

The immediate impact of ORV travel is to the surface, where low-growing vegetation is injured or destroyed. All ORV travel will affect vegetation. Soil and moisture conditions influence the ability of vegetation to recover in the short run. ORV travel compacts soils and reduces percolation rates. Compaction impedes water infiltration, gas exchange, and root growth (Lull, 1959; Steinbrenner and Gessel, 1955). Consequently, water is more apt to flow overland on the surface, causing rill and gully erosion. Natural productivity of the site is lessened because of the restricted root growth. This, in turn, causes a loss in vegetal cover, which also exposes more of the area to erosion. Erosion is not only unsightly but results in loss of topsoil, create gullies, and degrades stream quality.

Repeated travel over the same route or travel during wet weather can create ruts, which concentrates surface water and leads to gully erosion. Factors adversely affecting watershed conditions lead to increased sediment loads in streams and greater deposition of sediment in reservoirs and canal systems. Travel routes selected by ORV operators can be one of the major sources of stream pollution.

The operation of ORVs can also have seriously harmful effects on some wildlife species. Any concentrated ORV travel and long-term disturbance in some areas could affect wintering big game, breeding animals or birds, and nesting raptors. Animals of the remote open plains and tundras are particularly susceptible. Wintering animals can be inadvertently driven from traditional winter ranges into areas of deep snow. They may accidentally be forced into heavy exertion at a time when all their energy and reserves are necessary for survival. Prairie chickens, sagegrouse, and other grouse species annually carry out courtship and breeding activities on traditional strutting or booming grounds. Disruption of the breeding and nesting sequence might result in reduced nesting success.

Nests, young birds of ground and shrub nesting species, and other small

animals may be destroyed by surface vehicles travelling cross-country.

ORV travel will both complement and cause limited disruption to land used for purposes like grazing and recreation. Unless identified by the surface management agency or individual surface owners and protected, natural areas or locales with primitive and wilderness values could be damaged by mineral development and its related impacts.

Surface disturbance from ORV travel could cause direct damage to archeological features. The increased presence of man can lead to increased illegal artifact collection, increased damage to historic trails by ORV use, and the further loss of some historic structures or ruins.

Cutbank created by road construction.

Road Construction

In difficult terrain, road construction is a necessary part of the exploration phase of coal development. Access must be gained to bring in drilling and other equipment for evaluation of the coal resources. Unless otherwise designated by the land management agencies, road standards are very low with primary intent being only to gain access. Most new roads are of a temporary nature and can be obliterated.

Road and trail construction involves the grading (cutting and filling) of surface material. Bulldozers are commonly used. The operation removes vegetation, including trees, creates cut banks and casts aside deposits of soil and other disturbed material. In areas where small streams or gullies are not bridged, graded loose material is pushed into the drainage. Flood runoff commonly washes out the gully plug, resulting in increased sediment production. Soil and vegetative disturbance exposes more area to the erosive forces of rain and wind. The road serves to concentrate runoff water and increase the erosion hazard.

Road construction initiates conditions temporarily conducive to erosion, soil compaction, and landslides and influences soil organisms. Road and trail construction usually involves the removal of topsoil. If cast aside, this life-sustaining material is often the source of stream sediment. Trails, because of compaction and concentration of surface runoff are often the forerunners of gullies.

Because populations of bacteria are highest in the surface soil, actions that remove or destroy it have the worst effect. Actinomycetes, fungi, lichens, and algae are vital to healthy soil. Many multicelled soil-dwelling animals depend upon plant debris and organic matter for their food source. Removal of surface soil or destruction of the organic soil fraction will reduce these populations and adversely affect certain vertebrates.

Certain soil areas within the coal provinces are more seriously affected by disturbance than others. The most fragile soil areas are badlands and rough, broken land. Badland areas have poor vegetal cover and steep slopes. Access across steep or rocky slopes requires more soil disturbance than across more gentle topography. More cuts and fills are required when constructing roads across steep terrain. Road cuts and fill slopes are exposed to erosive forces. Some shale areas weather into montmorillonitic clays,

Soil and vegetative disturbance exposes more to the erosive forces of rain and wind. The road may serve to concentrate runoff water and increase the erosion hazard.

which are easily eroded. Some shale areas are high in sodium salts which compound all the erosion and stability hazards (Sandoval, Bond, Power, and Willis, 1973).

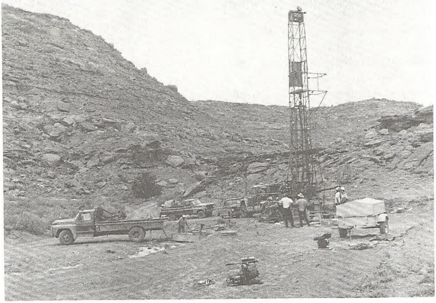
Wildlife populations are invariably affected by incursions into their habitat. Elk are more sensitive than others, but all wildlife populations are sensitive during certain times of the year. The effects vary considerably in severity depending upon the intensity of the exploration, the sensitivity and adaptability characteristics of the wildlife species involved, and the stability of the biotic communities disturbed.

Road construction results in limited loss of livestock and wildlife forage, crops, and timber and woodland production when roads are built across lands capable of sustaining these uses.

Disturbance of the surface might also result in accidental loss of human interest values. Archeological and historical values may be altered or destroyed by surface-disturbing activities. Additional roads will allow greater access to remote areas and may result in increased illegal artifact collecting activities.

Road construction affects the basic character of the landscape by removing vegetation and disturbing the soil, thus changing the color, texture, and lines of the environment. In areas of open space, roads introduce strong lines into the landscape that are visible for many miles. Cut and filled areas are often highly visible and may alter the landscape for long periods of time under most conditions.

Travel on unpaved roads creates dust except during wet weather. This dust is highly visible and to some individuals impacts on the esthetics of the area. Heavy travel may to varying degrees be adverse to the existing land uses in the area.



Exploration drilling.

Exploratory Drilling

Drill holes may penetrate several groundwater aquifers and possibly result in leakage between aquifers or to the surface with potential degradation of water resources. Leakage between aquifers can result in contamination of good-quality water by poor-quality water or loss of good-quality water to an aquifer of poor quality. Intermingling of ground waters may result in lowering of water levels in one aquifer resulting in increased pumping costs at nearby domestic municipal wells. Improper plugging of drill holes on areas subject to flooding can result in drainage of surface waters into the aquifers. This can be beneficial or adverse, depending on the quality of the surface water.

Preparation of the drill site, where necessary, results in the removal of vegetation, compaction of soils, and creation of unprotected cut banks. These factors encourage wind and water erosion. Surface-disturbing activity may lead to degradation of surface water quality.

The drilling operation increases and prolongs the same factors disruptive to wildlife in the coal exploration phases previously discussed. Sediments or cuttings produced by drilling or the drilling fluids could cause contamination of soil, vegetation and surface water adversely impacting wildlife habitat. Livestock could also be affected. Unplugged drill holes could be a hazard to humans, livestock, and wildlife.

Drilling can have beneficial impacts on wildlife. In arid areas, artesian wells with good-quality water can be of benefit to wildlife if allowed to continue flowing.

Drill site preparation affects other land uses because of the required surface disturbance. The major impacts will be on lands used for grazing, crop production, timber production, watershed production, and recreation.

Drilling programs usually result in little increased human activity and new business in the area. Occasional prolonged large scale drilling programs may result in increased human activity and new business in an area.

The drilling program could adversely affect esthetic values by altering scenic landscapes and creating noise pollution. The surface disturbance can result in loss of human interest values by endangering archeological and historic resources. Increased activities by man will result in further problems in protecting these values.

Exploratory Excavation

In some situations where coal deposits are near the surface, or when bulk coal samples are needed, pits are excavated in the exploration process. Heavy equipment is used to excavate the overburden and expose the coal. This procedure results in considerable disturbance of the surface area. Vegetation is removed, and soil material rearranged by the excavation process. Livestock forage and wildlife habitat will be lost by the operation. Erosion and downstream sedimentation may occur. If pits are not covered promptly, they pose hazards to domestic animals, large wildlife species, and

humans. Excavated areas are considered by many to be esthetically displeasing. Usually, the overburden is replaced a short time after the necessary sample or other information has been gathered.

Development

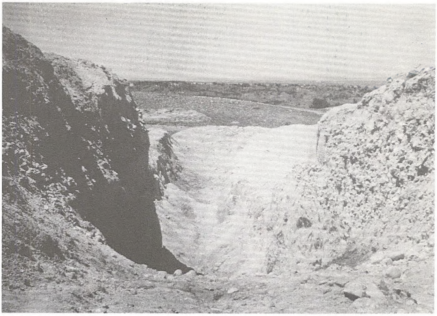
Underground Mines. After issuance of a coal lease, development of the mine can begin. This generally involves more intensive exploration, as previously outlined, development of a detailed mining plan designed to bring about mining with the least possible adverse effect, and development of the necessary permanent mine components. These features include construction of permanent access roads, shafts, slopes or drifts, and preparation for the surface plant. Development occurs underground, but this produces considerable coal and rock that must be disposed of or stored in the immediate vicinity. The rock material may be used as fill for leveling areas near the mine entrance and for construction of roads. Any excess must be disposed of in a waste area. Considerable surface disturbance can occur as the underground mine is being developed. In some cases it is necessary to relocate the surface drainage in the area.

Surface-disturbing activities and depositing of fill material will result in loss of vegetation along with rearrangement and compaction of the soils. Soil organisms will be lost or adversely impacted. Unstable fill deposits that are subject to erosion and failure may be created. Overall, disturbance of the surface will probably contribute increased sediment loads to streams and drainages when they are present.

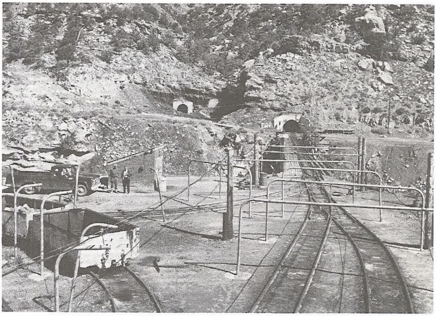
The effects upon wildlife will include displacement or possible destruction of most animals and their habitat on the surface land areas disturbed as a result of underground mine development. In a larger area surrounding these disturbed areas, certain animals, for example, elk, could be displaced due to their inability to tolerate either the habitat impairment or the influx of human activity or both.

Any extensive removal of vegetation and the soil disturbance accompanying surface development may accelerate erosion causing sedimentation of aquatic habitats within the drainage. This can reduce the food production and spawning habitat necessary for the survival of any fish species present. Road culverts and small stream channel changes during road construction can create impassable barriers for fish. Unless road culverts are installed with consideration for adequate fish passage, some species could be adversely affected. Channel changes may also develop velocities that fish cannot negotiate. The actual development of shafts, drifts and slopes for initiation of underground mining is not expected to have substantial impacts on wildlife.

Sinking a mine shaft can disrupt groundwater supplies. The possible effects include: (1) drainage of aquifers; (2) contamination of aquifers containing good-quality water with poor-quality water; and (3) changing groundwater flow patterns. If large amounts of poor-quality water are



In some situations where coal deposits are near the surface, or when coal samples may be needed, pits are excavated in the exploration process.



Portals and part of track layout at U.S. Steel's Geneva Mine in Carbon and Emery Counties, Utah.

Surface disturbance is created by this underground mining operation at Hiawatha, Utah.

encountered during shaft sinking, unless sealed off, disposing of the water could create problems.

When active mine development begins, the immediate vicinity around the mine entrance becomes dedicated to coal production. There is a change in type of land use from extensive open space use to intensive use. Surrounding areas are generally in natural or undeveloped condition and may be adversely affected unless protected. Fishing waters that occur in downstream areas from potential underground mine developments could be adversely affected.

Population effects during the development phase are relatively significant because development is likely to overlap facility construction. Workers will likely be primarily from outside the area and many will only be temporary residents. The influx of these people may produce temporary overloading of schools and all public services. Some workers from the development phase are likely to become permanent employees and carry on to the production phase. A portion of the group can therefore be considered quite stable as they establish themselves in the community after a reasonable time.

Surface Mines. Surface mine development normally begins with more detailed development drilling, development of a mining plan, and the initial stripping operation. In quarry-type mining procedures, the initial spoil material is stockpiled in an area where it will become the final fill material when the mine is exhausted. Strip mining usually begins at the outcrop or edge of the commercial quality coal. Overburden is moved away from the coal, in the direction opposite to which mining is to proceed. Large equipment to be used in the stripping is moved or assembled at the mine site in the development state.

In situations where the strip mines are planned in or near surface drainage channels, some stream diversion may be necessary. This operation will disturb lands in the natural flood plain. If improperly planned, the stream may attempt to return to its original course especially during extreme flood events. This causes excessive stream bank erosion and addition of sediments to the stream. Should the stream channel return to areas of waste coal or carbonaceous shale, surface water could be contaminated, thus lowering the water quality to downstream users.

Stripping operations remove vegetation in the stripped area and may cover existing vegetation in other areas where the initial strip material is stockpiled. Stripping of the soil results in destruction of soil characteristics and mixing of the soil with the parent rock material. Removal of the natural soil results in loss of important physical, chemical, and biotic content. The soil structure is pulverized, decreasing its permeability and causing compaction, which increases the erosion potential (Wischmeier, et al., 1971).

Stripping topsoil when it is in a wet condition increases the magnitude of the compaction damage.

Populations of bacteria are highest in the surface soil. Actions that dislocate the topsoil will adversely affect these populations. Heterotrophic micro-organisms depend upon organic matter for food. These organisms cannot live when the supply of organic material is interrupted. Stripping the soil of vegetal cover stops the supply.

Stripping activities destroy some wildlife species, eliminate wildlife habitat, and create barriers to their normal movement. The activities of man tend to displace certain species of

A stream has been diverted to allow strip mining at the Amax Coal Company's Belle Ayr Mine near Gillette, Wyoming.

Overburden is removed with shovel and trucks at Belle Ayr mine.

wildlife that have difficulty in adjusting to his presence.

Perennial stream channels diverted around mine areas can be obstacles to migration and death traps for small animals if left steep sided. Stream diversion may also seriously reduce the stream's potential for producing fish and other aquatic wildlife. The variety of habitats found in natural streams, i.e., riffles, meanders, pools, undercut banks, etc., are lost or reduced in channelized streams.

Many operations in surface mine development are carried on in conjunction with the production operations, as mining of an area proceeds. For this reason, the effects of surface mine development on wildlife are discussed in greater detail in a following section entitled "Production," a section concerned with the impacts of mine production.

Initiation of mine development results in dramatic changes from existing uses, which are likely to be grazing, crop production, watershed, and recreation. Due to the hazards in the strip-mining area, all other land uses on a given lease tract that is being developed are often curtailed or effectively eliminated until the land is finally restored.

Labor requirements for developing a stripping operation are not significant relative to underground mining so minimal population change can be expected. Initial workers are likely to continue with employment in the production phase.

Development of a strip mine has significant impacts on the esthetics of an area. The loss of the vegetation and the accumulation of spoil piles are displeasing to many of the population. Extreme difference in color and texture is evident between the spoil pile and the undisturbed area and the operation of equipment often results in dust, noise, and odors.

Mine Facility Construction

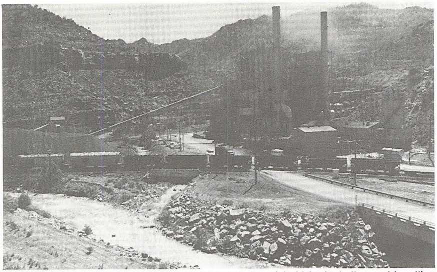
The mine operation requires construction of a complex of facilities including coal-handling and coal-loading equipment, coal crushers, storage bins, mine operation buildings, and a repair and maintenance shop. Power is needed at the site and is usually brought in rather than generated on site. Water and sanitation facilities are needed. Coal transporting facilities are necessary and may require use of a railroad spur or hauling on public roads. Slurry lines are employed on occasion, but are for long-distance transportation, so they are considered beyond the scope of this report.

If not already provided in the mine development, it is necessary to grade and level a large area for the plant operation facilities. Surface water drainages are often altered to gain space. Site preparation, therefore, causes surface disturbance, removes vegetation, and shapes and rearranges soil and the landscape in general. These activities may encourage erosion and may contribute to soil instability, sedimentation, and pollution of streams or drainage areas.

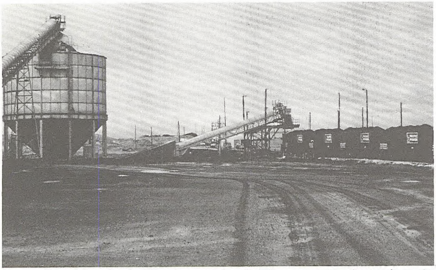
Plant facilities have adverse effects on soil organisms and soils. The living soils are destroyed if they are removed, reshaped, compacted, or covered with concrete, asphalt, or thick layers of gravel.

The construction of coal mine facilities affects wildlife by the displacement and in some instances destruction of their habitat. Areas adjacent to the facilities are often adversely im-

Loss of protective vegetation and accumulated spoil piles can be displeasing to many as this view in the Appalachian Mountains.


A mine operation requires construction of a complex of facilities including coal handling equipment, crusher, storage bins, mine operation buildings, and a repair and maintenance shop. This mine operation and electric power plant are at Castlegate, Utah.


Plant facilities have severe adverse impacts upon soil organisms and soils. This is Pittsburg and Midway's mine near Oak Creek, Colorado.


Construction of the mine facilities, transportation facilities, and utilities frequently results in major new intrusion in an area influencing current land uses and the environment in general.

pacted. Certain animals for example elk, and sage grouse, may be displaced due to their inability to tolerate the influx of human activity.

The extensive removal of vegetation and the soil disturbance accompanying construction may accelerate erosion and cause sedimentation of aquatic habitats within the drainage, thus reducing food production and spawning habitat necessary for the survival of many fish species.

Poorly designed or constructed roads with deep cuts, fences, power lines, and channelized streams can obstruct normal movements and migration of wildlife or place serious hazards in their path. Fences must be carefully located since they can cause high deer and antelope mortality, especially in the winter. Some animals are killed on roads, particularly in areas or during periods of high animal concentration or across migration routes. Power lines may endanger flying and perching birds through collision with wires while flying and electrocution when perching.

Construction requires large quantities of sand and gravel. Many times the only available supply is in or adjacent to streams which could adversely affect downstream fish life or water quality.

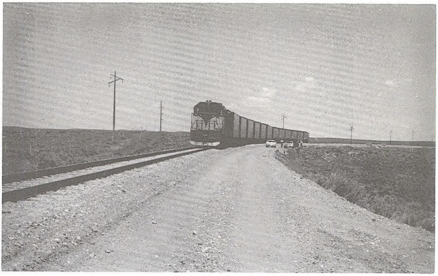
Construction of the mine operation facilities and associated transportation systems and utilities can be a major new intrusion in an area influencing current land uses and the environment in general. Coal-mining areas of the past have left many relics of mine facilities. If maintained properly, however, the mine plant facility intrusion may be modified.

Railroads are a primary commitment of land surface to this use. Fences constructed to keep livestock out of the area serve as a barrier to some wildlife species. In the open space areas common in the coal regions, railroads are a major esthetic intrusion. Large trestles, overpasses, cuts, or fills are features that frequently have unpleasing visual impact for some people.

The construction phase has the highest labor requirement. Many workers are transient workers that travel regularly from one job to another. Consequently, they reside in

temporary housing or in mobile homes. Efforts are made to hire local people for the less skilled jobs. A significant level of temporary population influx can be expected for large operations. Large population influxes adversely affect all public services and schools. An accumulation of mobile homes commonly results in outlying areas. Health and sanitation problems could arise. Problems in enforcement of regulations can be expected. Local populations have some difficulty in adjusting to large influxes of people and the accompanying social problems. Economic factors like employment and income in the area are affected by the construction phase.

Intensive construction activities will destroy all archeological features that may exist on the construction sites. Additionally, the increase in activity could cause pressure on the surrounding archeological resources in the form of illegal pot hunting or artifact collecting, or other illegal recreational use of the lands.



Railroads are a permanent commitment of land surface to this use.

Pot hunters excavating site in Montana disregarding archeological values and land use regulations.

Production

Underground Mines. Effects from underground coal extraction occur both under ground and at the surface. Removal of the coal could disrupt the groundwater hydrology and perhaps result in subsidence. Both problems can be manifested at the surface and influence land uses and various components of the environment.

Water pumped from underground mines may be acidic or may contain high concentrations of trace elements and total dissolved solids. When this water is discharged to surface streams it has been known to deteriorate the quality of the stream water. Even where acidity is neutralized, concentrations of trace elements may persist over long reaches of streams, or the discharge water may greatly increase the dissolved solids content of the receiving stream.

The collapse of beds overlying a mine can cause an increase in infiltration over these areas. This can increase mine drainage problems, especially where the collapse occurs beneath stream channels. Besides the possibility of polluting surface waters drained through mines, the water may be diverted through the mine workings to a different surface drainage system or subsurface aquifer resulting in loss of flow in the originating stream or contamination of a good quality aquifer. The disturbed surface resulting from collapse can also lead to increased erosion and sediment in streams, especially in hilly areas. Drainage of aquifers containing good quality water could result in lowering the water table thus increasing pumping costs. In addition, water circulation patterns (flow lines) can be altered over a considerable area.

Mine dewatering may result in drainage of aquifers containing good quality water. This can occur in aquifers below the mine workings as well as above.

Waste piles and retention ponds are sources of acid drainage and possibly harmful trace elements. Drainage diversion channels are susceptible to rapid erosion and collapse during extreme flood events if improperly constructed. This can cause detrimental effects on the environment in addition to the increased danger to life and property.

Subsidence can have an adverse effect on wildlife populations. Some surface holes and cracks resulting from

subsidence of mined-out areas will be direct hazards to certain forms of wildlife. Small animals are particularly prone to falling into openings. Burrowing animals such as prairie dogs, ground squirrels, marmots, burrowing owls, etc. could be affected. Conceivably, species such as the "threatened" Utah prairie dog or the black-footed ferret could be harmed. Changes in surface flows and runoff patterns due to subsidence can alter available moisture situations, influencing plant distribution and altering wildlife habitat.

Lakes, springs, ponds, and marshes capable of supporting various aquatic species can be either created or destroyed by subsidence. Loss of existing water in arid areas would be particularly disastrous to many wildlife species. However, creation of a dependable water hole or spring could benefit wildlife significantly. Increased soil erosion from subsidence would adversely affect downstream aquatic habitats subject to sedimentation and siltation. Spawning beds could be degraded, and aquatic habitat reduced in productivity.

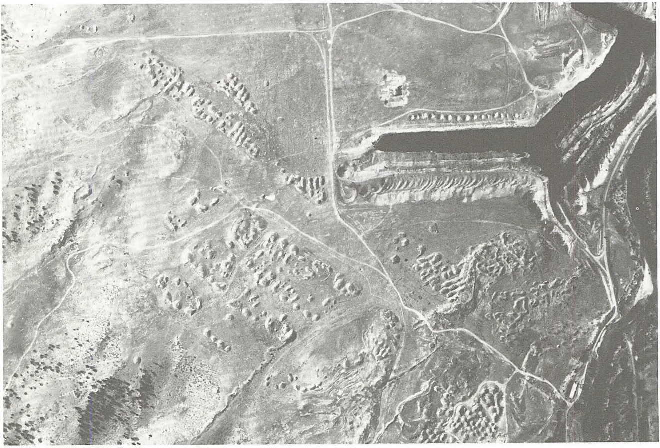
Subsidence from coal mining can destroy the potential for building homes or other structures on the land surface. Underground coal mining at shallow depths could result in land surface that is unsafe for any use by man or animals. In the latter case, sudden violent collapse of the surface over mined-out areas could occur.

Underground mining followed by subsidence, provides avenues for air to enter mined-out areas. Coalbed fires then become potential hazards, emitting smoke and gases. Further subsidence would then be induced and coal is wasted.

Most coal mining operations produce waste material in the form of bone, gob, and shale that is either left underground or taken to the surface for disposal. Mine dumps are located in the vicinity of the mine mouth, or coal cleaning plant. The sites are usually esthetically displeasing. Disposal sites at active mines are devoid of vegetation and subject to erosion and unless the material is wet, the operation creates dust. Smoke from fires on the waste piles degrades the air quality in the area.

Mining and coal cleaning processes create dust and fine coal material that must be disposed of in the waste disposal area. The crusher operation results in local noise pollution and coal dust, which affects air quality in the immediate vicinity.

Underground mining is hazardous to the health and safety of the mine employees. As shown in Table 3-1 underground mining has had nearly twice the fatalities as strip mining in frequency rates per million man hours. Furthermore underground mining has resulted in 6 times the fatalities. Stringent mine safety regulations have been reducing the accidents in mining.



Subsidence of the ground surface is common above many abandoned mines. The lake, used for recreation, upper right, was formed by surface mining done after the underground workings were abandoned.

Underground mining employs large numbers of people. In rural areas where the Federal coal is generally located, a coal-mine payroll can contribute significantly to the local economy and provide many new jobs. Unless the new coal mine is in an active mining district, the additional labor force will have to migrate to an area when a coal mine operation develops. Influx of large numbers of people affect existing social, ethnic, economic, political, and cultural institutions significantly. Schools and other public services are often overloaded to the point that quality is adversely affected. If predevelopment planning by the local government or the company is not done, the existing population of an area will suffer.

Destruction of esthetic qualities of the environment is somewhat localized in underground mining except where subsidence into shallow-mine workings produces a surface area covered with sink holes. The manner in which waste materials are disposed of significantly affects the form, color, and texture of the environment. An operation of heavy equipment that causes dust, noise, and to some degree, odors is not esthetically pleasing in some of the environments in which coal mines will be operated.

Surface Mines. Coal deposits that lie near the surface are most economically and safely mined by surface methods.

The operation completely eliminates existing vegetation, disrupts soil structure, alters current land uses, and to some extent changes the general topography of the area being mined. The surface is temporarily dedicated to mining use until it can be reshaped and rehabilitated.

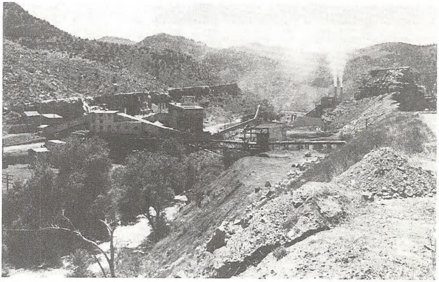
Surface mining can have impacts on the hydrology of all provinces. Deterioration of stream quality can result from acid mine drainage, trace elements in mine drainage water, high dissolved solids content of mine drainage water, and increased sediment loads. In addition, waste piles and coal storage piles can yield sediment to streams, and leached water from the piles can be acid and contain trace elements.

Surface mining may also have impacts on ground water supplies. These

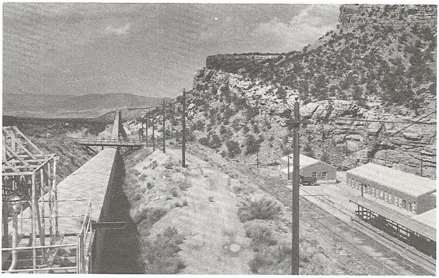
Table 3-1
Coal Mining Fatalities and Frequency Rates
(Fatalities/Million Man Hours)

	Underground		Strip		Auger	
Year	Fatalities	Rates	Fatalities	Rates	Fatalities	Rates
1970	220	1.20	29	0.55	4	1.08
1971	149	.86	23	.39	3	.79
1972	127	.68	20	.39	1	.58
1973	107	.57	16	.30	1	.59

Bureau of Mines September 13, 1974



Waste material from a mining operation at Castlegate, Utah can be either left underground or taken to the surface for disposal, right foreground.



Coal is transported at U.S. Steel's Geneva mine in Carbon and Emery Counties, Utah by covered conveyors.

A 22-yard shovel, background, removing overburden, Velva mine, Velva, North Dakota.

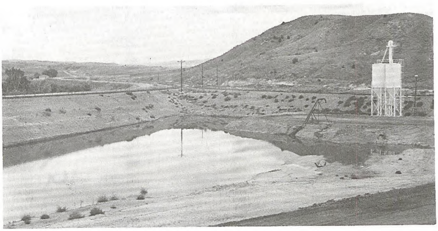
include: (1) drainage of usable water from shallow aquifers, (2) lowering of water levels in adjacent areas and changes in flow directions within aquifers, (3) contamination of usable aquifers below the mining operation due to downward leakage of poor quality mine water, (4) increased infiltration of precipitation on spoil piles. Where all the coal is removed during surface mining operations, and little or no carbonaceous shale is present in the spoil, increased infiltration may result in: (1) diminished runoff and erosion from spoil piles, (2) recharge of good quality water to the shallow ground-water aquifers, (3) increased baseflow to nearby streams. However, where coal or carbonaceous shales are present in the spoil, infiltration could result in poor quality water which might contaminate both ground water and nearby streams for long periods of time if contaminates are present. Lakes formed in abandoned surface mining operations are more apt to be acid if there is coal and carbonaceous shale present in the spoil piles, especially if these materials are near the surface of the piles and contain pyrite. Increased infiltration of precipitation on spoil can be, in some cases, beneficial.

Extreme flood events can cause severe damage to improperly constructed or located roads, plant facilities, waste and coal storage piles, settling basin dams, surface-water diversion structures, and the mine itself. Besides the danger to life and property, large amounts of sediment and poor quality water could have detrimental effects many miles downstream from the mine site.

Removal of soil from the area to be surface mined destroys the natural soil characteristics by pulverization of the structure, disruption of the organic matter cycle, and by compaction. The micro-organism population and nutrient cycling processes are upset by movement and redistribution of the soil. The general disturbance and compaction of the soil results in conditions that are conducive to the erosion.

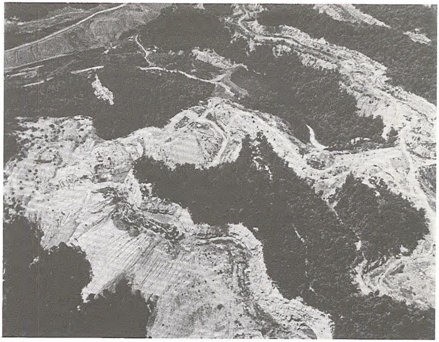
Surface mining of coal causes direct and indirect damage to wildlife (Spaulding and Ogden, 1968). The impact on wildlife stems primarily from disturbing, removing and redistributing the land surface. Some of the impacts are short term and confined to the mine site, others have far-reaching, long-term effects. The direct effect on wildlife is the destruction or displacement of all species in the areas of excavation and spoil piling. The more mobile wildlife forms like game animals, birds, and predators, etc. will leave these areas. The more sedentary animals like invertebrates, many reptiles, burrowing rodents, burrowing owls, ferrets, badgers, etc. may be directly destroyed. If streams, lakes, ponds, or marshes are filled or drained, fish, aquatic invertebrates, amphibians, etc. will be destroyed. Animal populations displaced or destroyed can eventually be replaced from populations in the surrounding ranges provided the habitat is eventually restored. An exception could be the loss of an endangered species.

Many wildlife species are highly dependent on the vegetation growing in natural drainages. This vegetation provides essential food, and sometimes nesting and escape cover during various seasons of the year. Any activity that destroys this vegetation lowers the quality and quantity of the habitat of ponds, reservoirs, marshes, and wetlands essential for waterfowl, shore birds, and many terrestrial forms. The head-of-the-hollow fill method is of particular significance to the destruction of endangered species and other wildlife habitat in the Appalachian



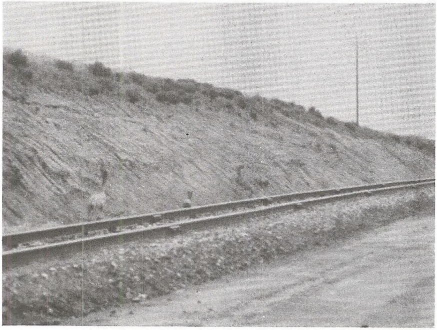
The strip mining process can interrupt groundwater aquifers and results in accumulation of mine water in the strip area. Above, Decker mine water is used for dust control on roads.

regions. The narrow, V-shaped, steep-sided hollows near ridge tops are frequently inhabitated by potentially endangered or restricted animal and plant species. This is especially true in the arid regions where the bulk of Federal coal reserves is located. These hollows often offer the only conditions suitable for a wide range of species. Extensive spoiling into these canyons would eliminate important habitat for a wide variety of species.


Soil removal can cause a general distrubance and compaction of the soil resulting in conditions that are conducive to the erosion as shown in this Appalachian Mountain area.

Broad and long-lasting impacts on wildlife are caused by habitat impairment. The life requirements of many animal species do not permit them to adjust to changes created by land disturbance. This is impairment of the habitat component called living space. The degree to which a species or an individual animal will tolerate man's competition for space varies. Some species will tolerate very little disturbance before moving. In instances where a particularly important habitat is restricted, such as a lake, pond, or primary breeding area, the species could be eliminated from the lease area. In some instances, secondary impacts are evident. Big game and other animals displaced from their home ranges may be forced to use adjacent areas already stocked to carrying capacity. This overcrowding usually results in degradation of the remaining habitat, lowered carrying capacity, reduced reproductive success, interspecific and intraspecific strife, and potentially greater losses to the population than the originally displaced animals.

Overburden removal if improperly done, causes loss of topsoil, exposes parent material and creates vast wastelands. Pit and spoil areas are not capable of providing food and cover for most forms of wildlife. Without rehabilitation, these areas must go through a weathering period which may take a few years or many decades before it becomes suitable habitat. With rehabilitation, the impacts on some species are less severe. Man cannot immediately restore natural biotic communities. He can, however, give nature a boost, through rehabilitation efforts geared to wildlife needs. Rehabilitation not geared to the needs of the endemic wildlife species, or improper management of other land uses after rehabilitation can preclude re-establishment of many members of the original fauna.


The degree to which a species or an individual animal will tolerate man's competition for space varies.

Degradation of aquatic habitats has been a major impact from surface mining. It may be apparent to some degree many miles from the mining site. Silt and sediment pollution is common with surface mining. Research by Spaulding and Ogden in 1968 in Kentucky indicated sediment yields increased 1,000 times their former level as a direct result of strip mining. In this Kentucky study approximately 1 acre-ft of sediment is produced annually for every 80 acres of disturbed land (Spaulding and Ogden, 1968). The effects of silt and

sediment on aquatic wildlife vary with the species and amount of pollution. These pollutants can kill fish directly, bury spawning beds for important species like trout and salmon, reduce production of aquatic organisms, reduce light transmission, alter temperature gradients, fill in pools, and spread flows, etc. These changes destroy the habitat of some species and sometimes enhance the habitat for undesirable species.

Existing conditions are already marginal for some of the cold-water game fish and anadramous species. Sedimentation of these waters can result in their elimination. The heaviest silt and sediment pollution of a given drainage normally comes within 5 to 25 years after mining (Spaulding and Ogden, 1968). In some areas, unrevegetated spoil piles continue to erode even 50 to 65 years after mining.

The presence of toxic waste materials exposed as a result of surface mining can affect wildlife by eliminating habitat and by causing direct destruction of certain species. Lesser concentrations can suppress productivity, growth rate, and reproduction of many aquatic species. Acids, dilute concentrations of heavy metals, and high alkalinity can cause severe wildlife damage in some areas. The duration of toxic waste pollution can be long term. Estimates of the time required to leach exposed acidic materials in Appalachia range from 800 to 3,000 years (Spaulding and Ogden, 1968).

In certain situations, surface mining can have beneficial impacts on some wildlife. Where large, continuous tracts of forest, bushland, sage-brush, or grasslands are broken up during mining, increased edges and openings are created. Preferred food and cover plants can be established in these openings to benefit a wide variety of wildlife. Under certain conditions, creation of small lakes in the strip area can also be beneficial. These waters may become important water sources for a variety of wildlife inhabiting adjacent areas. Many lakes are initially of poor quality as aquatic habitat after mining (Waller, 1967). These lakes may require various levels of habitat enhancement and management to be of significant wildlife value.

To make an accurate evaluation of the net positive or negative impact on wildlife where positive impacts appear possible, one must be sure to relate the benefits or damages to kinds of benefits and species involved. As an example, it may not be a benefit to rehabilitate an antelope range to excellent grass-forb summer range if it was previously crucial sagebrush winter range limiting the herd in the area. Or, the habitat and population of an abundant already widespread species may be greatly enhanced while the habitat and a few individuals of a threatened or uncommon species is lost.

The surface mining operation and coal transportation facilities are fully dedicated to coal production for the life of the mine. Existing land uses such as grazing and crop and timber production are temporarily eliminated from the mining area until rehabilitation processes have been completed. High value, intensive land use areas like urban and transportation systems are not normally affected by mining operations. If mineral values are sufficient, these improvements may be removed and replaced in an adjacent area.

Surface-mining operations have resulted in creation of highwalls as high as 200 feet. Such highwalls may result at the end of a surface-mining operation where stripping becomes uneconomic or where a mine reaches the property line that is the extent of a current lease or holdings. These highwalls are hazards to man, wildlife, and domestic livestock. They may impede normal wildlife migration routes. In Appalachia, there are over 20,000 miles of highwalls created by coal mining. In some cases, highwalls circumscribed entire mountains (Spaulding and Agden, 1968).

The impact and final shape of highwalls is similar to that of highway cuts. They can be designed to be esthetically pleasing, or they could be dangerous and form barriers. The impact of the manmade slope will vary with the natural terrain and surroundings of the area.

Coal mining may affect the development of other minerals in the same site. There may be surface sand and gravel deposits, benetonite beds, commingled uranium, or oil shale deposits affected by coal development. Occa-

These boys are enjoying the free fishing in Sallie Buffalo Park near Cadiz, Ohio, courtesy of Consolidation Coal Company's Central Division. The lakes are stocked with bass, bluegills, bullheads, trout and crappie. No licenses are needed.

In Appalachia there are over 20,000 miles of highwalls created by coal mining. In some cases highwalls circumscribed entire mountains.

sional shallow gas or petroleum reservoirs could also be affected by disrupting weak bedding planes or fault zones associated with the reservoirs.

Natural fires have occurred in coalbeds underground. When coalbeds are exposed, the fire hazard is increased. Spontaneous ignition is caused when coal oxidizes and the air flow is insufficient to dissipate the heat. Weathered coal (smut) can also increase the ground temperatures if it is left on the surface. Almost all fires in solid coal are caused by man, lightning, and forest or prairie fires.

Surface-mining operations are considerably less hazardous to mine employees than underground operations. In 1971, 24 fatalities were recorded in the United States in open-pit operations, a rate of 0.46 per 1 million man-hours, considerably less than underground mining (National Coal Association, 1972).

Due to intensive mechanization, surface mines require fewer workers than underground mines on an equivalent production basis. Population influences are therefore not as significant. In low-population areas, however, local populations cannot provide the needed employees so there is migration to the area because of the new jobs created by the mine. Unless adequate advance planning has taken place on the local government or company level, the new population will cause overcrowded schools and demands to public services that cannot be met. Some social instability may be created at the local level.

The impact of surface mining on geological features of human interest could exist in the strip-mine area. Geomorphic and geophysical features and outstanding scenic resources could be sacrificed by indiscriminate issuance of a lease and subsequent mining. Paleontological values might be endangered due to the disruptive activities of blasting, ripping, excavating, etc. On the other hand, formations could be more clearly visible for study and the chances of finding new fossil specimens enhanced by exposing the subsurface formations.

Stripping of overburden will eliminate and destroy all archeological and historic features unless removed beforehand and carefully documented.

The extraction of coal by surface mining disrupts virtually all esthetic elements of the landscape to most of the population although in some cases only temporarily. The alteration of landforms impose conflicting configurations. New linear patterns appear as the material is extracted and waste piles are developed. Different colors and textures are exposed as vegetative cover is removed and overburden dumped to the side. Dust, vibration, and odors are created, affecting sight, sound, and smell. The grand scale of the operation impacts significantly on the quality of the environment.

Coal Beneficiation

The process of coal beneficiation involves the installation of plant facilities to upgrade coal quality by separating out the low-quality material. The process can use either air or water for separation. Waste material is disposed in the immediate vicinity of where it is produced. Under some conditions, the quantity of waste material is significant.

Separation processes produce waste material that contains carbon, trace elements, sulphur, and other material. Unless special disposal precautions are taken, this material can become dust adversely affecting all types of flora and fauna in the fallout area. The waste pile may also be subject to erosion and leaching. Adjacent land and drainage areas could become polluted by contaminants produced in the beneficiation process unless precautions are taken.

When a water-separation process is employed, a slurry impoundment is used for storage of the fine waste material and recycling or evaporation of the water. The slurry material may contain concentrations of dissolved solids, heavy metals, or other contaminants that could be leached into adjacent drainages or underlying aquifers and lower water quality. Storage reservoirs such as this are subject to breaching or overfilling by floods if improperly designed. Contaminated material would then be carried to streams and drainages, adversely affecting the land and water resources.

The fine slurry material in the pond area must be wetted or covered at all times, or it will be subject to becoming airborne under windy conditions. For this reason, abandoned pond disposal areas must be covered and revegetated to prevent wind and water erosion.

Disposal of waste material from coal beneficiation is important to wildlife because these materials could cause chemical and sediment pollution of terrestrial and aquatic wildlife habitats. Use of water in the cleaning process may cause excessive water demands that could lower water tables and dry up small lakes, ponds, or small streams if the water comes from local sources. In arid areas, all water sources may be critical to wildlife. Loss of these sources would destroy aquatic species and many land species.

Unless waste is returned underground or to the strip pits, it could have long-term adverse impact. If deposits are indiscriminately dumped on slopes they tend to be unstable. Landslides may occur which would be a hazard to anything in the immediate area of the slide. Fires are a problem in the waste disposal area, contributing

Ungraded spoil banks will effectively eliminate all other land uses while active and could have long-term adverse impacts unless properly rehabilitated.

Land slides are common and damage vegetation downslope from contour strip mining in Appalachia.

smoke to the atmosphere and adversely affecting air quality.

Coal Marketing

Coal marketing may involve transporting coal for relatively short distances to mine-mouth power facilities by railroad, truck, or conveyor systems or long-haul transportation. This report is primarily concerned with short-haul transportation. All types of transportation systems, even cars, produce noise and air pollution and create safety hazards. Coal dust can be released from the moving carriers and accumulate along the transportation route. Unless trucks travel on paved or wetted road surfaces, dust is stirred up. Air and land pollution is esthetically displeasing and can adversely affect surrounding vegetation, wildlife, and land uses. The movement of heavy equipment, trains, and associated human activity and noise along roadways or railroad tracks can drive some wildlife species out of the area. Roads and railroads commonly cause high direct animal mortality and right-of-way fencing can hinder big-game migration especially if the fences are net wire.

Energy for transportation is usually provided by diesel fuel used in trucks and locomotives. The engine emissions contribute to air pollution and produce considerable noise.

Rehabilitation of Disturbed Areas

The disturbed area rehabilitation program involves the shaping of the spoil pile in the case of strip-mine operations, return of available topsoil, and planting of vegetation. The rehabilitation process has some land-disturbing activities, but the outcome is intended to have beneficial impact on the environment.

Land disturbance in rehabilitation creates a situation conducive to wind and water erosion. Soil is compacted by some of the operations. Sediment levels in streams can be temporarily increased by the activities. Environmental impacts from the rehabilitation process are short-term trade-offs that are necessary to reestablish vegetation and return a site to some predetermined degree of productivity and usefulness.

When mined land rehabilitation is not accomplished immediately after mining, natural plant and animal successions begin. Rehabilitation efforts beginning many years after some wildlife species have reestablished naturally will cause a temporary setback or loss of these species.

Rehabilitation aimed at establishing an entirely different ecosystem in terms of vegetation, topography, and land use may affect wildlife. Some lands could be rehabilitated for intensive human use, others could be rehabilitated especially for wildlife or for intensive agriculture. The types of wildlife that would be able to survive in each situation would vary greatly.

IMPACTS UNIQUE TO CERTAIN PROVINCES

Environmental conditions may vary significantly from one coal province to another, causing differing impacts. Certain local conditions exist that can best be explained by examining the situation in a specific manner. This

section of the report is intended to bring out some of the more important variations that are evident in coal development. The circumstances are discussed by coal province.

Pacific Coast Coal Province

Northern Alaska Coal Field. The settlement and development of this region offer challenges to technology to preserve the fragile tundra. Development will be many times more expensive than at lower latitudes. Perennial water sources are very limited, and any land-disturbing activities will contribute to water pollution. Life exists in this northern region in a delicate balance. Minor disruptions will cause significant problems for flora and fauna. Rehabilitation will be difficult with minimal success in the short run. Long-lasting effects on erosion and stream sedimentation can be expected.

Discharge of warm mine water from depth can cause increased snowmelt and erosion. Coal dust from surface operations can cause increased snowmelt, which would result in increased erosion. Also, the coal dust would be washed away with the snowmelt and could cause pollution of streams.

Since wildlife populations are significant in the tundra regions, the loss of habitat is of particular concern. The rate of tundra vegetation recovery from disturbance is very slow. On an area in western Alaska where lichens, an important caribou food, were removed from the ground surface, they recovered to only two-thirds of their former abundance after 43 years (United States Department of the Interior, Environmental Statement ..., 1972). Disturbance or loss of aquatic habitat can occur because of the demand for gravel used in construction. Streams are the principal gravel source in the tundra. Fauna displaced from their territory cannot be expected to find a suitable new habitat unoccupied.

Disturbances due to human activity are significant in the tundra region because larger animals have no place to hide. Air traffic for mineral exploration, cargo and passenger hauling, and recreational flights is a source of harassment to animals on the tundra. Threatened species or those whose status is undetermined, such as the polar bear, grizzly bear, and wolverine, are particularly vulnerable to increased activity.

Coal marketing may involve transporting coal for relatively short distances to mine mouth facilities. This train is carrying coal 15 miles to Pacific Power's Dave Johnston Mine near Glenrock, Wyoming.

Many types of transportation systems produce noise, land and air pollution. This 200 ton carrying capacity coal hauler is at the Glenharold mine near Stanton, North Dakota.

Harassment from mechanized ground equipment can also be serious. Disturbances of nesting waterfowl is a probable in some areas if mining occurs. Nest abandonment on a grand scale could result. The coastal beach areas are especially important to waterfowl during the summer and for caribou grazing and fox denning.

Anadromous Fish. Anadromous fish and species dependent upon brackish and saltwater estuaries, beaches, and mudflats can be severely affected by silt, sediment, and toxic material pollution. Many of these species support important commercial operations in addition to sport and recreation use.

Rocky Mountain Coal Province

Mountain Subdivisions. The many factors that make the Rocky Mountain area inviting to the recreationist and tourist has created an added land use, mountain recreation and rural residential community development. Subdividing is taking on major proportions in mountain areas. Patented mining claims and homestead lands are the primary source of private lands which

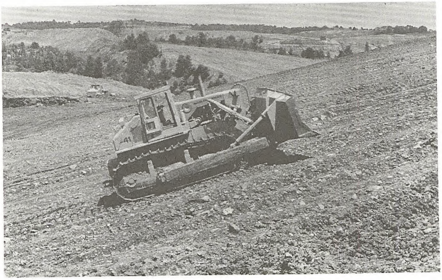
are being subdivided. These tracts are often intermingled with Federal lands administered by the Forest Service and BLM. In the Colorado mountains and valleys alone, over 380 rural subdivisions involving some 285,000 acres are located adjacent to public lands. Coal lands within the San Juan River and southeastern Uinta Coal Regions of Colorado are specifically affected by these developments. Under mineral patent and homestead laws, leasable minerals are reserved to the United States. These minerals, including coal, are therefore subject to leasing. Underground mining may cause subsidence, adversely affecting an area that has been developed or is planned for summer homes and resorts. Generally, the coal fields around the Uinta field are deep underground workings with minimal potential for subsidence.

The rehabilitation process has some land disturbing activities but the outcome is intended to have a beneficial impact on environment.

Hydrology. The semi-arid conditions in the Rocky Mountain Coal Province result in many unique impacts due to coal mining. Many of the strippable coal beds are near or underlie surface drainage channels. Therefore stream diversion channels are necessary at some mine locations. Many acres of thick spoil may be left on natural flood plains. An extreme flood event could wash out the diversion channel and return the flood waters to the original flood plain. This would result in large amounts of easily erodable sediment being carried by the stream. If much waste coal and carbonaceous shale were present in the sediment, contamination of the water might cause additional problems, especially to valuable alluvial aquifers downstream from the mine. Use of water for irrigation during reclamation would have impacts on other potential water users. Contamination or drainage of usable aquifers due to underground mining can have severe impacts because there is seldom an alternate source of water available to users. Disturbance of the ground surface, though limited in much underground mining, causes increased sediment loads in streams. This in turn reduces the quality to downstream users, and decreases the useable life of reservoirs created by dams on the streams. If underground mining methods in hilly terrain result in collapse of the ground surface, the resulting increased sediment loads to streams can be especially severe.

Most streams in this province are intermittent or have very little flow part of the year. Therefore there is little streamflow available for dilution of mine drainage. Release of wastes and sediment during high flow periods can have adverse effects on important alluvial aquifers downstream from the operations. Fine silt and clay from coal tailings can plug up the surface of the flood plain reducing infiltration and soluble ions including trace elements released from the coal debris can contaminate the alluvial aquifers. The coals in this province generally contain little pyrite, and the soils and stream waters are often highly alkaline. Therefore acid mine drainages probably would not be as great a problem as in some other provinces. In addition to the potentially undesirably high dissolved solids content, trace elements can be expected to persist in mine drainage waters.

Any large addition of mine water to the Colorado River or its tributaries containing a high dissolved solids content would have impacts on users in



Bulldozers and scrapers arrange the spoil pile to a desired slope and contour.

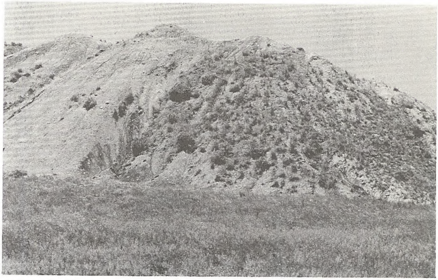
the lower portions of the river, and could affect the quality of water discharged to Mexico.

On-site power plants, coal gasification plants, and coal liquification plants require much water, especially for the large plants envisioned for this region. As much of this region is a water-short area, water will either have to be imported to the plant site or the plants must obtain water rights to adjacent streams. Either way, large amounts of scarce water would be diverted from other possible beneficial uses.

Coals in this region are known to contain concentrations of radioactive elements and other trace elements (Zubovic, and others, 1961, Denson, and others, 1959) which are concentrated in the ash although coals containing high concentrations of radioactive elements are of extremely limited areal extent, at least in North Dakota and Montana. Storage of ash in waste piles can result in contamination of aquifers below the waste piles. Erosion of these piles during intense rainfall events can contaminate streams. Fly ash released from smoke stacks can cover large areas, and would be carried to streams following intense rainfall events. Due to the sparsity of intense rainfall events, appreciable concentrations of fly ash could be deposited over an area between storm events.

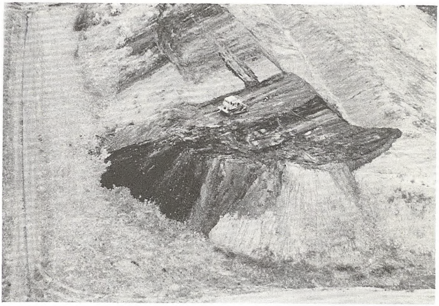
Most of the towns in this area have sparse population, and water supplies and waste treatment plants often are barely adequate for the present inhabitants. The increased labor force necessary to operate the mines and power plants could put severe strains on present water supply and waste treatment facilities in many small towns in this region. This could lead to water shortages and increased pollution in streams receiving waste discharge. Water use by plant personnel for bathing and sanitation would cause added impacts on sparse water supplies. In addition disposal of these waters, if untreated, could have severe impacts on nearby streams.

Game Populations. A major concern in the Rocky Mountain Coal Province is coal development and its impact on game populations. The area is the major producer of moose, elk, mule deer, desert and Rocky Mountain Bighorn, and sage grouse, in the lower 48 States. Antelope populations are also of primary importance. Significant adverse impacts of concern include destruction of crucial big-game winter range, interference with big-game migrations, destruction of sage grouse breeding and nesting complexes, long-lasting effects of habitat loss in arid cold desert areas, disruption and displacement of big game in winter concentrations, and deterioration or destruction of highly important desert water sources.



Unless mined land rehabilitation is accomplished immediately after mining, natural plant succession begins.

The large populations and winter concentrations of elk and mule deer in the Green River and Uinta regions can be temporarily disrupted by coal-mining operations. Underground mining, however, will not have as great an impact as surface mining. Relatively small winter habitat losses could assume very serious proportions because of existing problems of insufficient winter range, especially in the Green River and White River drainages. This is extremely critical when considering specific geographic areas such as the



Rehabilitation aimed at establishing an entirely different ecosystem in terms of vegetation and topography.

Piceance Basin area of Colorado, which is the winter range for the largest migrating mule deer herd in the United States.

Antelope and sage grouse populations and winter ranges would be most seriously affected by surface mining in parts of the Green River and Wind River regions.

In various locations scattered throughout most of this province, the advent of extensive highwalls, fenced roads, railroads, etc. would cause particularly heavy wildlife losses and habitat damage by interfering with major deer, antelope, and elk migrations. Migrations are more common and usually more necessary in the northern parts of the province, so impacts there could be more severe.

Much of the coal province is rough, arid cold-desert cut by canyons. Soils are shallow and poorly developed. Due to this harsh environment, impacts on wildlife habitat has long-term implications. Restoration of lost habitat on a given site may take 20 to 30 years if no effort toward reclamation is made. However, with proper reclamation, the time would be much less, (R.L. Hodder, Montana State University).

The shortage of water in the arid portion of the province would magnify adverse effects. Loss or degradation of a particular water source would probably adversely affect wildlife populations over a large area. Conversely, when water sources are created by mining activities, they often prove highly beneficial to wildlife.

Wild Horses. Much of the vast wild horse habitat in the Rocky Mountain Coal Province is underlain by coal. Lease and development of this resource could alter individual herd ranges.

The level of industrial development could influence wild horses. Present populations can likely sustain themselves with low-level development without adverse impact to the range resource. Higher development levels might temporarily restrict ranges and lead to overgrazing. In the long-term, the range resource could deteriorate adversely impacting watershed condition. Increased soil erosion and stream sedimentation can be expected. In the final analysis the results could be reduction of wild horse habitat.

Kaiparowits Plateau. Development of the Kaiparowits Plateau in extreme Southern Utah is a highly controversial and complex resource management question. The plateau has more than one million acres underlain by coal. Total reserves have been estimated to exceed 20 billion tons. The coal is thick bedded, high quality, and low in sulfur. Recovery will be by underground methods. Present leases cover nearly 125,000 acres.

To the south of this vast energy reserve is the Glen Canyon National Recreation Area encompassing scenic Lake Powell. Annual visitation approaches one million. Projections for 1985 anticipate two million visitors. Surrounding National Resource lands have many significant scenic, natural, and primitive values important to tourists and recreationists.

Two large power-generating complexes are being planned which will use Kaiparowits coal. Water storage in the upper Escalante River area could affect the scenic Escalante Canyons wildland natural area. Power plant emissions could adversely affect other nationally significant recreation areas by degrading air quality and reducing vision. National Parks and monuments within 100 miles include the Grand Canyon, Canyonlands, National bridges, Rainbow Bridge, Capital Reef, Bryce Canyon, Zion, and Cedar Breaks.

Due to the remote location and sparse population, development of the proposed power complexes at suggested levels could lead to a "new town" with a maximum population projected up to 20,000. A population increase of this magnitude is 800 percent over the 1970 level of Kane County, Utah. A significant impact on the environment could result from this urbanization. Monumental challenges face local governments in providing services to accommodate this population impact.

Oil Shale. The Rocky Mountain Coal Province contains the largest deposits of oil shale and associated minerals in the United States. Coal beds underlie the valuable oil shale deposits. The thicker seams and higher quality coal is located at great depths (over 4,000 ft). Under present technology, the coal is not economically recoverable. The likelihood of coal mining preceding oil shale development is therefore remote. Any effect on the oil shale from coal development is not anticipated.

Exploration of the coal could, however, cause problems in localized areas. The Piceance Basin in western Colorado has large aquifers of fresh and saline water above the valuable oil shale deposit. Drilling operations and improperly plugged holes would result in exchange of water between aquifers and possible storing of large quantities of water in the mineralized areas. Water could also move to the surface by artesian flow and cause problems in an active mining area.

The interrelationships between the oil shale and coal resources are not fully understood. It is recognized, however, that development of one should not proceed without conservation of the other.

Northern Great Plains Coal Province

All the coal regions in the Northern Great Plains Coal Province are in semi-arid areas. Consequently, any effects on hydrology are especially harmful. Contamination or drainage of usable aquifers will severely affect this area because there is seldom an alternate source of water available to users. Disturbance of the ground surface, though limited in underground mining, causes increased sediment loads in streams. This in turn degrades the quality of water for downstream users and reduces the usable life of reservoirs. Where underground mining methods in hilly terrain result in collapse of the ground surface, the resulting increased sediment loads to streams can be especially severe. Most streams in this province are intermittent or have very little flow during part of the year. The low discharge of the streams limits their ability to dilute contamination.

Release of wastes and sediment during high flow periods can have adverse effects on important alluvial aquifers downstream from the operations. Fine silt and clay from coal tailings can plug up the surface of the flood plain, reducing infiltration, and trace elements leached from the coal

debris can contaminate the alluvial aquifers. The coals in this province generally contain little pyrite, however, the soils and stream waters are often highly alkaline. Acid mine drainagess would not be as great a problem as in other provinces. Trace element concentrations can be expected to persist in mine drainage waters. Shales overlying Paleocene coals may contain from 300-500 ppm total nitrogen (Power and others, 1974). This could cause a buildup of nitrate in surface or ground water around spoil piles.

Storage and interbasin diversion of water for coal mining and power production in the Powder River Basin will change stream habitat to reservoir habitat, will cause increased evaporation losses and environmental change along water diversion routes.

Game and Waterfowl Populations. The Northern Great Plains Coal Province has significant game and waterfowl populations. The fringe and mountainous areas have many species common to the Rocky Mountain Province. Production is not as extensive, however, except for antelope. The large antelope herds of this province are susceptible to extensive habitat losses from surface mining, minemouth industrial complex construction, and construction of road, railroad, pipeline and canal systems. These transport systems can be expected to cause significant losses to antelope by interference with movements and proper use of available winter habitat.

Destruction and drainage of aquatic habitat and disturbances of breeding and nesting waterfowl could cause temporary losses of thousands of waterfowl annually in the Fort Union coal region. Parts of this region are in the famous "Prairie pothole" waterfowl production area where duck-producing potholes may average 30 per square mile.

In the wide-open expanses of grassland common in this province, the occasional islands of rough topography, open timber, and riparian woodlands have very high food and cover values for wildlife. Many species could not survive in the grasslands without these relatively limited areas. Destruction of these habitats during surface mining and related operations without adequate reclamation might result in losses among these species. In North Dakota, the woody draws are considered some of the highest quality wildlife habitat in the State (Morgan, 1973). North Dakota ranks last among the fifty states in woodland acres.

Parts of the Powder River Basin and Fort Union coal regions are within the presently known range and adjacent to the highest known concentration of the endangered black-footed ferret. Coal mining and related activities could eradicate local populations and severely reduce the existing populations.

Small elk herds found in the Powder River breaks of Wyoming and the Bull Mountains of Montana will probably be driven out or reduced to a few scattered animals should their key ranges be mined.

Human concentration in the general region, will cause competition between man and wildlife for food, cover, water, and living space at many levels.

Operations requiring large amounts of water can cause widespread loss and deterioration of aquatic wildlife habitats. In arid regions, waters will have to be imported from other areas, broadening the impact to many wildlife populations. Locally, desiccation and death of wildlife and habitats may occur where water tables are lowered and stream flows reduced. Large water import operations may, unless adequately preplanned, bring changes in wildlife numbers, productivity, distribution, movements and species composition over large land areas and in major waters where canals diversions, dams, etc. cause significant ecological changes.

Air and water pollution, if not adequately controlled, will have significant impacts on wildlife. Air pollution can destroy vegetation, reduce its productivity and decrease its palatability, impacting species dependent upon it for food and cover.

Air pollution fallout can also degrade surface waters directly or through runoff from polluted soils. This may reduce water drinkability for wildlife and may destroy or deteriorate aquatic habitat and aquatic wildlife populations.

New industry is usually accompanied by more people, more money, more free time, and greater demand for outdoor recreation. In rural areas, this sudden increase in people living and recreating on the land, may displace wildlife and reduce habitat. Demands for homes, utilities, water, roads, outdoor recreation facilities, etc. invariably threaten wildlife resources and bring about a myriad of changes within wildlife communities.

Changes in access patterns in a region may have definite impacts on man's utilization of game and fish species. Game and game-fish may be subjected to increased exploitation pressures in general. Local and easily accessible populations may be excessively exploited. Large areas around mining-industrial complexes may be restricted to hunting and fishing. These considerations may complicate management of wildlife and wildlife habitat by government agencies, requiring more intensive management. It may become necessary to reduce big game, predator or "nuisance" animal populations displaced by human activities to prevent overuse of remaining habitats and conflicts with other human uses.

Interior Coal Province.

Wildlife Populations. The primary impact in this province from leasing and mining of Federal coal is the potential contribution to acid mine drainage. Toxic waste materials exposed during mining operations could contribute to chemical pollution of the highly productive aquatic habitats in the Arkansas River drainage. Instances are known where waters emerging from underground mines are highly acid, destroying aquatic life downstream (Hendricks, 1937).

FACTORS AFFECTING THE COMPLETENESS OF COAL EXTRACTION

Many factors can affect the completeness of coal extraction, but a factor having great impact on the environment at one mine may have little or no impact at another. An objective of Federal coal leasing is to obtain maximum recovery of Federal coal with minimum impact on the environment. One factor can influence another, and the factors that affect the completeness of coal extraction in-

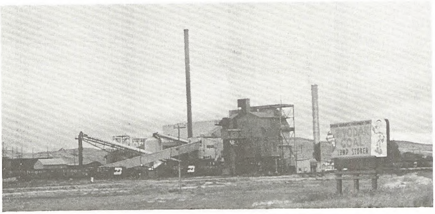
clude mining method, depth of coalbed(s), thickness of coalbed(s), distance between coalbed(s), condition or type of roof and floor, safety, marketability, supervision, mining equipment, and productivity.

Completeness of recovery can be expressed as the percentage of the coal recovered from a particular bed within a designated area. Or it can be expressed as the percentage of coal recovered from the deposit or resource affected by mining. The first method of expression is the one in general use, and when it is used, the percentage recovery from strip mining can average up to 90 percent. Where underground methods are used, the Bureau of Mines has determined the recovery will be 57 ± 1.7 percent (95 percent confidence limits) (Lowrie, 1968). While the percentage of recovery from auger mining varies from 20 to 50 percent, the average is about 25 percent.

Expressing the percentage of recovery as the percentage of coal recovered from a particular bed within a designated area when other bed(s) are damaged or destroyed will result in an erroneous figure. It is erroneous because other bed(s) damaged or destroyed are partially or completely lost. In the interest of conserving our coal reserves, percentage recovery should show any beds lost in part or in full. Then a mining plan submitted for a Federal coal lease that allows such losses, without good reason, should not be approved. Often a modification of the mining plan could reduce or eliminate such loss of coal. Three important factors on which such a determination can be based are economics, mining methods, and marketability.

For this programmatic EIS recoverable coal may be mined from coalbeds of 28 or more in. thick for the Eastern and Interior Province and for all other provinces, those beds of bituminous coal, 60 or more in. thick or those beds of subbituminous or lignite 60 or more in. thick. There will be exceptions, but such exceptions should be considered by individual mining plan.

Up to 90 percent of a single coalbed has been extracted by underground mining methods from a designated mining area, but such is an exception that can happen only when conditions are ideal. On the other hand, when it is necessary to hold subsidence to a minimum for the safety of the miners and/or to protect the land surface, as little as 20 percent of a coalbed may be extracted. The depth and thickness of the bed, condition of the roof and floor, and the available mining equipment are the main factors that influence underground recovery. Regardless of these factors, if surface subsidence must be prevented or minimized, completeness of extraction will be minimal. For minimal extraction, the probable method would be room-and-pillar with small rooms and large pillars, and no pillar removal. Such could also be used to protect overlying coalbeds for later removal.



Secondary impacts include a potential mine-mouth, coal-fired generating station.

Degree of difficulty in multiple-bed mining varies inversely as vertical distance between the beds mined. Mining may be impossible in beds separated by a 40-ft interval, while at an interval of 150 ft to 200 ft, the problems may be minimal.

Supervision and productivity have relationships to each other and can affect recovery. Haphazard supervision of development and production, such as having too many openings, leaving broken coal in mined areas, or not adhering to safe mining limits, can reduce recovery.

Coal recovered within the mining area from a single bed or multiple beds by surface mining will range from about 80 to almost 100 percent. The mining area is limited by the economics of overburden removal. With few exceptions, up to 150 ft of overburden can be removed at an area stripping operation before equipment limitations are reached. Where contour stripping is used, maximum overburden thickness, attributed to equipment limitations, is generally about 100 ft. The exception for contour mining is when the head-of-hollow method can be used. Its limitations, beside economics, is the quantity of spoil that can be placed in the hollow(s). When a coalbed or multiple coalbeds are of sufficient thickness to allow profitable extraction beyond the limits of stripping machinery, other methods such as the open-pit method can be used.

Supervision and productivity of surface operations, as in underground mining, can affect recoverability. Uncovering coal too far in advance of its removal can cause slacking. Spoil not placed beyond the bed or allowed to slide back upon the coal requires leaving a fender of coal to protect the remaining coal. Improper cleaning of the top of the coalbed causes waste. Highwall sluffing onto coalbeds can result in unrecovered fenders of coal.

Completeness of recovery in both underground and surface mining is reduced when part of the coalbed must be left in place to prevent loading equipment from sinking into the floor. In underground mining, it is reduced when part of the coalbed must remain in the roof to gain the necessary roof support.

Marketability governs whether the coal is mined or left in place; deter-

mining factors include calorific (heat), ash, moisture, sulfur, and sometimes sodium content. Overlying coalbeds are often bypassed to mine a deeper bed of higher quality. When this occurs and the lower bed is mined using underground mining methods, the overlying beds may be damaged by subsidence to the point they cannot be mined. When surface methods are used, the overlying beds of marginal or submarginal value may be discarded with the overburden.

The low percentage of recovery from auger mining is attributed mainly to the fact that no subsidence can occur while augering is being done. If it should occur, neither the auger nor the coal can be removed from the hole. Therefore, to assure subsidence will not occur, a large part of the coal remains between the holes and in the roof and floor for support. The amount left depends upon the condition of the roof and floor. If the roof is hard and dense and the floor is sound, more coal can be extracted than if the roof can support itself only across short spans or the floor is prone to swelling.

Because of equipment limitations, the maximum size of an auger hole is about 8 ft in height and 200 ft horizontally. This reduces the recovery percentage in seams of greater thickness. Because of equipment limitations and the terrain, most of the auger mining has been done in the Eastern and Interior Provinces where thick coal seams are not as prevalent as they are in the western United States.

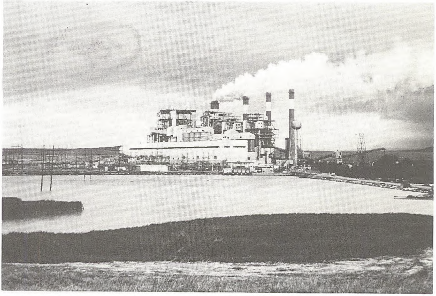
Safety, supervision, productivity, and marketability at auger mining operations will affect the recovery of coal, as in other mining methods.

COAL-FIRED, MINE-MOUTH, ELECTRICITY-GENERATING PLANTS

Secondary impacts include the potential coal-fired, mine-mouth, electricity-generating plants that could be built if coal resources are leased and the overall social and economic impacts that can be expected from all aspects of coal development and utilization. In terms of significance, these impacts will be among the more significant resulting from development of the coal resource.

The environmental impacts from coal-fired, power-generating stations have been identified in the Southwest Energy Study and in numerous environmental impact statements on specific plant proposals. Some of the potential impacts from this type of development include:

- Emission of particulates that will reduce visibility under certain atmospheric conditions. Impacts could be minor or relatively intensives depending on the level of development.
- Emissions of concentrations of SO_2 that could be hazardous to plant and animal health.
- Emissions of oxides of nitrogen which if they reach the ozone layer in the stratosphere can reduce its effect of shielding humans from ultra-violet light which causes skin cancer (Johnston, 1973).
- Emissions of vapor from water cooling towers and ponds, creating visual pollution and impacting on esthetics.
- Emissions of trace mineral elements including mercury, lead, cadmium, fluorine, boron, and manganese.
- Consumption of vast amounts of water resources, some of which will occur in regions where supplies are limited. This action will cause widespread loss and deterioration of aquatic wildlife habitats. The consumed water will also be denied to other possible beneficial users.
- Change to intensive land use of significant acreages now in natural condition, affecting open space and other esthetic values.
- Construction of new power transmission lines over extreme distances to power marketing centers. New corridors will be required that will introduce power lines to new areas and adversely impact on current land uses and the landscape in general.
- Increased human concentration and activity in the plant area and in the general region that will cause competition between man and wildlife for food, cover, water, and living space at many levels.
- Thermal pollution to streams, rivers, and lakes that will affect aquatic habitat and result in changes in species composition. The effects can be negative or positive depending on the animals involved and one's point of view.
- Construction of new reservoirs and water conveyance facilities that will eliminate existing land uses, but create beneficial water facilities.



Emissions of fog from water cooling towers and ponds, creating visual pollution and impacting on aesthetics.

- Disturbance of archeological and historical sites at the plant site and along transmission and transportation routes and in areas made accessible to ORV's. Effects increase exponentially with improvement of access, sensitivity of sites, rarity of sites, and the recorded knowledge of culture in that area.
- A few coals in the Western Regions contain high concentrations of radioactive elements (Zubovic and others, 1961; Denson and others, 1959) which are concentrated in the ash. Storage of ash in waste piles can result in contamination of aquifers below the waste piles. Erosion of these waste piles can contaminate streams. Fly ash from smoke stacks can cover large areas which can make the effect more widespread.

Wiki-up remains in Montana.

POTENTIAL EXTRACTIVE TECHNIQUES

There are potential extractive techniques in the experimental or theoretical stage, and by today's standards, it does not appear that these techniques will be the source of large amounts of coal or energy in the near future. If they are developed to a commercial scale, they will affect the environment. Regardless of the technique used, all will cause surface subsidence, and from what is known about them, effects from surface subsidence should be similar to those caused by underground mining.

In addition, any of the techniques used will require construction of a surface plant. With the exception of the completely automated underground mining technique, which will have a mine plant similar to any underground coal mine, all techniques will require pipelines. Such piplines will probably run from a central plant to holes drilled into the coal seam(s). As the mining process continues, the network of pipelines and recovery holes will cover a progressively large area. Ultimately, an operation could cover several square miles. The extensive drilling program and pipelines network will necessitate roads. These roads are envisioned as main hard surface roads, with one road crossing the mine property in each direction; laterals, probably graveled, extending from the main roads; and temporary roads, probably more like trails, extending from the lateral roads.

Impacts on the geology, topography, and hydrology will be greatest from the subsidence. Even greater impacts may result from necessary pumpage which may lower water levels and cause water quality degradation. Plant water disposal may cause water pollution problems. Socioeconomic impacts will not be as significant because the operations will not be labor intensive. Surface plant disturbance from the roads and pipelines will intensify the effect on soils, vegetation, wildlife, and land uses, open spaces, esthetics interest, and human value. In four of the eight potential extractive techniques, the process will generate gases that could pollute the air unless proper precautions are taken.

The use of the completely automated underground mining techniques or the technique of flushing solid coal to the surface could create a waste pile on the land. Its size would depend

Influxes of people associated with the exploration and construction phases cause temporary overloading of school systems and all public services while adding limited additional tax base. The picture shows a coal mining town in Appalachia.

upon the quantity and type of impurities in the coal and the amount of coal produced. The waste disposal technique and rehabilitation program will be important aspects of mitigating the impact of this type of coal recovery.

SOCIAL AND ECONOMIC IMPACTS

The overall social and economic impacts from coal development and utilization are dependent generally beyond the scope of this statement and dependent on the level of development that will be attained. Potential mine-mouth generating plants have been identified in various studies concerning western coal resources.

The North Central Power Study of 1971 (U.S.D.I., 1971) identified 42 potential mine-mouth plants over 1,000 MW in generating capacity. These potential developments vary in size from 1,000 to 10,000 MW each. They include 21 sites in Montana, 15 in Wyoming, 4 in North Dakota, 1 in South Dakota, and 1 in Colorado. In total, the potential plants have a combined generating capacity of 180,700 MW.

The Southwest Energy Study of 1972 (U.S.D.I., 1972) identified 11 potential plants or additions to existing generating stations. The combined generating capacity projected to year 1990 exceeded 30,000 MW. Power-generation sites include 4 in Utah, 3 in New Mexico, 2 in Nevada, 1 in Arizona, and 1 in Colorado.

In addition, other potential sites have been identified in the west since the above studies were completed. Some of these are documented in the "Report on Water for Energy in the Upper Colorado River Basin," published in July 1974. For example this study indicates coal fired plants presently being planned in Colorado and Utah are 6 and 7 respectively. Alaska is also known to have several potential plant sites. The potential coal-fired power-generating capacity must be considered great based on evaluation of the coal. Should this potential be realized it would result in a near complete allocation of uncommitted water resources.

To gain a perspective of the socio-economic implications of coal development and mine-mouth power generation, one must examine an increment of capacity and project the various implications or factors. A 1,000-MW unit is assumed for demonstration purposes (Table 3-2). There are innumerable variables that affect a coefficient of 1,000 MW, so a range of values is provided.

The various counties that will receive the major direct impact from the proposed generating plants are listed in Table 3-3. Examining the 1970 county populations, personal income, or employment, it is evident that even a 1,000-MW unit would significantly affect many of these sparsely populated areas. In an area such as Powder River County in Montana, installation of a 2,000-MW generating station would more than double the existing population, nearly double the present personal income, and more than double the present employment. In Campbell County, Wyoming, installation of 10,000 MW, which is only a minor portion of the identified potential, could result in a population increase of about 150 percent, personal income gain of more than 100 percent, and additional employment opportunities exceeding 100 percent. These examples include the total direct and in-

Table 3-2

Steam-Electric Power Generation – Resource Consumption and Employment

1,000 MW Capacity Will Result In:

Coal Production	3.0 - 3.5	Million Tons/Yr.
Water Consumed	7,500 - 15,000	Acre Foot/Yr.
Direct Construction Employment	4,000 - 6,000	Man Years
Total Construction Employment[1]	7,000 - 13,000	Man Years
Direct Operation Employment	250 - 350	Man Years
Total Operation Employment[1]	500 - 700	Man Years
Direct Population Impact	750 - 1,100	Persons
Total Population Impact[1]	1,500 - 2,500	Persons
Direct Construction Payroll	60 - 100	Million Dollars
Total Construction Employment[1]	90 - 150	Million Dollars
Direct Operation Payroll	3 - 3.5	Million Dollars/Yr.
Total Operation Payroll[1]	5 - 5.5	Million Dollars/Yr.

[1]Direct and Induced – Data from Southwest Energy Study, North-Central Power Study, and various existing generating plants in the west.

Appalachian coal mill and tipple.

Table 3-3
Social-Economic Data (1970) For Counties Anticipated to Receive Major Impact from Mine-Mouthed Generating Plants

State	County	Population (Numbers)	Personal Income (Million $)	Employment (Numbers)
Montana	Big Horn	10,057	22	3,163
	Carbon	7,080	18	2,393
	Custer	12,174	34	4,466
	McCone	2,875	9	1,030
	Powder River	2,862	8	1,115
	Richland	9,837	24	3,311
	Roosevelt	10,365	23	3,196
	Rosebud	6,032	13	2,238
	Sheridan	5,779	18	1,943
Wyoming	Campbell	12,957	46	4,803
	Carbon	13,354	37	4,963
	Converse	5,938	16	2,163
	Johnson	5,587	19	2,202
	Lincoln	8,640	21	2,894
	Sweetwater	18,391	52	6,982
North Dakota	Billings	1,189	2	389
	Bowman	3,901	10	1,453
	Mercer	6,175	14	2,132
	Oliver	2,378	5	779
	Slope	1,593	3	501
South Dakota	Harding	1,920	4	657
	Perkins	4,769	11	2,033
Utah	Carbon	15,650	38	5,108
	Emery	5,140	11	1,583
	Garfield	3,160	8	976
	Kane	2,420	6	801
Colorado	Delta	15,286	34	4,856
	Gunnison	7,578	19	2,589
	Mesa	54,378	145	20,125
	Moffat	6,525	18	2,503
	Routt	6,592	17	2,527
New Mexico	McKinley	43,208	74	11,277
	San Juan	52,517	116	15,159

1970 Census Data

direct effects resulting from a power development. Many other examples can be drawn from these data pointing out the significance of these industrial developments in a rural region.

The overall social and economic impact that could result from development of the coal resources and construction of mine-mouth generating plants includes:

1. Influxes of people associated with the exploration and construction phase will cause temporary overloading of school systems and all public services while adding limited additional tax base.
2. Rapid expansion of population will create problems for local planning and zoning. Difficulties will result in the financing of public services to accommodate planned growth.
3. The influx of large numbers of outsiders that in many cases will outnumber existing populations and will adversely affect existing social and political structures.
4. Expansion of employment and personal income will alleviate local unemployment and low incomes but will cause social problems.
5. Increased human population combined with reduction of wildlife habitat will create demand for fish and game that will exceed supply. Conflicts between man and wildlife such as elk will lead to reduction in the number of wildlife. Greater restriction of hunting and fishing seasons will be necessary, and intensive management of wildlife and habitat will become essential.
6. Indian populations who are primarily accustomed to rural surroundings will to some extent become disoriented and adversely affected by the trend to urbanization.

Chapter Four

Measures to Mitigate Environmental Impact

Measures to Mitigate Environmental Impact

INTRODUCTION

This section describes measures and techniques that lessen or eliminate impacts. It includes discussion of surface management requirements that *must* be employed and enforced by administering agencies* This distinction is necessary, as many mitigating measures are not always applicable to specific situations, while others are so basically essential as to be universally applicable.

The three levels of legal control: Federal, state, and local laws, regulations and lease or permit terms, are significant factors in the prevention of potential environmental damage in coal leasing, mining and use in mine mouth plants. It is, however, the preventive and remedial techniques that mitigate the damage, not the laws.

The tools of laws and regulations require three other types of effort to be effective, involving the Federal administering agencies, local government, the Lessee or operator, and, at times, the public, to insure adequate enforcement. These are administration, cooperation and comprehensive land use planning.

Without the backbone of the legal, binding components, these latter three elements hold little possibility for effective mitigation of coal mining impacts. Where impacts on the environment are reasonably well understood, legal formal control elements of law, regulations, lease or permit terms can be effective in alleviating impacts, but their optimum effectiveness is still a goal to be reached.

Cooperation has usually been present in some degree with lessees and operators. Commitments to future generations can provide a moral direction. The desire to be thought well of and accepted by environmentally concerned citizen consumers reinforces and inspires ethics on the part of the majority of the coal industry. Interior Department regulatory guidelines now require soliciting involvement of other Federal, State, and local officials and interested organizations and individuals in coal leasing decision making processes. Public participation is a requirement in BLM Natural Resource Planning procedures.

Comprehensive Planning is becoming a standard operational procedure in natural resource management, not only in governmental resource agencies, but also in coal and other resource extractive industries. There is a great distance to go, as effective planning needs good, factual knowledge, which means research and manpower. With regard to ecological and social inter-relationships resource management agencies are just beginning the task of taking inventory of all natural and cultural resources.

Planning should be done for three distinct but related purposes:

1. To reduce the impacts on the way people live.
2. To integrate and balance natural resource use and development over a large, possibly regional, area within a national framework of consideration.
3. To reduce impacts at the specific coal mining and energy conversion locations and fringes immediately adjacent.

Natural Resource Mangement Planning

All resources of Federal land, including minerals like coal, receive consideration under a comprehensive multiple-use planning system. Federal land-managing agencies, such as BLM and the Forest Service, use sophisticated systems to produce land-use plans that define future courses of action within a given geographic area. Land-use decisions are made after consideration of many factors, including Federal policies and objectives, capabilities of the resources, economic and social factors, public and interest-group views, and anticipated environmental impacts.

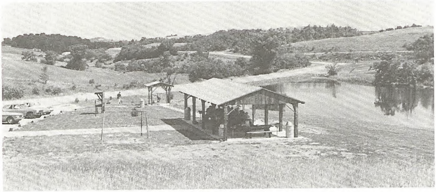
Interdisciplinary planning mitigates the effect of resource use by weighing the various uses to determine their potential compatibility and identifying the land-use constraints necessary to preserve other uses or resources in a geographic area.

Federal land-managing agencies seek the active involvement of the public, interest groups, and other agencies in developing appropriate plans for the management of all natural resources. It is by public participation in the early stages of consideration that all facets of concern can best be brought into focus. Such expressions of opinion and fact, supplemented by additional research where needed and coupled with a clear understanding of public objectives, are the basis for

effective resource management planning.

The initial field action is a complete inventory of all the resources in the planning area, and gathering of information on local, regional and National demands. This information is used along with public input to set objectives and to propose resource recommendations that are considered in the planning process to reach long-range land use management decisions. Federal management of non-renewable resources such as coal considers the use and development of coal (mining).

The inventory process identifies existing public land resources including: air, water, soil, vegetation, minerals, timber, wildlife, livestock, wild horses and burros, recreation and open space areas, historic and archaeological values, and intensive land use areas. Public interests at local and regional levels are contacted for input and assessment of relative resource values. The comprehensive planning process generates a management framework plan that defines the resource uses permissible in a geographic area. Following the framework plan, a coordinated resource management plan may be required for an individual resource. These field level plans identify where a program such as coal leasing can move forward, and where because of the constraints upon the program, the program cannot be allowed due to incompatibility with other resource values.



The final use of the land should be determined prior to mining so spoil-banks can be recontoured to fit the need. Recreational area created on an area that has been surfaced-mined. This is Sallie Buffalo Park, which was developed by Consolidated Coal Company's Central Division near Cadiz, Ohio.

Regional and Local Planning and Zoning

The indirect and secondary impacts of resource development can be regulated through regional and local planning and zoning. Resource development creates jobs that attract people and generate income. If the resource development is significant in relation to the existing economy, the potential impacts are great. The adequacy of community components such as existing housing, space for new housing, utility systems and services, schools, physical and mental health services, police and recreation services are important considerations. Expanded services such as these must be well planned in advance of need.

The options and methods of regulating local area growth and expansion are primarily with local governments. Varying degrees of success have been evident in the past. The Federal Government's role has been in encouraging local planning in a professional manner and by sharing the cost through a grant program. The action part of the program (zoning) is carried out by local citizen representatives. The trend toward more environmental concern and quality of life considerations is improving local input. The time consideration (long range vs short range) in management of land use however, will continue to be a problem.

In the past some large coal developments have resulted in building of "Company Towns" owned by the coal company. In these cases planning and zoning requirements must be met by the company. Indications now are that the trend is away from "Company Towns" with more dependency on local governments and individuals. In undeveloped locales, financial participation by industry may be essential due to a previously limited tax base. Contribution of funds or prepayment of taxes by the company would help to alleviate early financing problems in municipal planning and community construction.

In normal surface mining operations, overburden from the newly excavated strip is placed in a previous excavation, graded, and revegetated. Aerial view shows lakes, trees and crownvetch in area that was reclaimed after it was surfaced-mined. Light-colored area beyond the trees in photo shows large field of crownvech in bloom. A drive-in theater also is visible in this photo.

In all the above planning efforts, studies and research may be needed to supply missing information before further planning can take place.

A public information and education program, with full disclosure of all actions and results, planned or in progress is necessary. This assures that changes forced upon present and future generations will result in minimal detrimental effects.

Impacts On People

Coal extraction and use for power production in an area where it has not existed before, will affect the habits, customs, life styles and values of people. Impact begins with the first rumor that coal might be mined and ends long after the last person involved in the industry has left. Mitigation of impacts will be discussed for the process as a whole.

Social

All mitigating measures, like the impacts they are intended to ameliorate, are likely to have significant social, political, and economic implications. Planning, as discussed previously, is an all important measure to mitigate the impacts on social structure when a community "booms."

A well-balanced public information effort in communities fearing social, economic, and political impacts due to boom psychology helps to mitigate the effect by giving the people sound information on what to expect. Use of local people as exploration employees may alleviate adverse impacts and resentments. This is especially true in regions where Indian populations are involved and apprehension is great regarding change and the in-migration of outsiders. Careful avoidance of religious and cultural landmarks during exploration can reduce potential social conflict areas.

Thorough understanding of existing local social, political, and economic values and conditions by those involved in exploration and developement could go far toward mitigating exploration and development impacts and local expectations of potentially radical change. Temporary needs during initial construction and development must be the first phase planned for. Coal extraction and energy conversion development siting serve to mitigate many impacts by locating such activities adjacent to existing larger communities and in areas where these activities have already been developed to some degree. Community development away from Indian ethnic groups could also keep such groups from losing their cultural and ethnic identity. At the same time, programs could be initiated to enable existing rural communities and Indian groups to benefit from change by decreasing their isolation and increasing economic opportunities. Maximum employment of local people by incoming and expanded coal operations and development should be planned for, and training programs and employee recruitment oriented accordingly. In situations where local populations will be heavily impacted and perhaps outnumbered by immigrants due to coal development, orientation programs for the newcomers could lessen impacts by helping them to understand the existing social, economic, political, cultural, ethnic/religious fabric. Where possible, native and Indian peoples should be helped and encouraged to maintain their own social, cultural, and ethnic identities.

All manner of services, such as more intensive game and fish management to sustain hunting and fishing opportunities, and community recreation facilities should be planned in advance of need to mitigate impacts and place emphasis on the more beneficial aspects of change.

Reserves built from severance, corporate or individual income or other taxes can mitigate the "bust" effect as non-renewable natural resources are depleted and an area economy winds down.

Laws To Mitigate Impacts

Numerous Federal laws regulate and govern the circumstances of and operations involved in coal development and energy conversion. The National Environmental Policy Act of 1969 (Act of January 1, 1970, Public Law 91-190; 83 Statute 852) is the single most significant Federal law requiring protection and conservation of the environment in Federal administration of national resources. The Act imposes a number of requirements affecting coal mining and energy conversion. Most specifically, the NEPA requires the following:

1. That all Federal agencies consider the existing environment, and potentials for impacts on it, in all their administrative and management actions, to the fullest extent possible.
2. Preparation and publishing of an environmental impact statement for legislation and other Federal actions that will significantly affect the natural and human environment. The intent of this section of the NEPA has been determined to be "an environmental full disclosure [of proposed actions and the effects they will have] requirement."

The Clean Air Act as amended (42 USC 1857, et seq.) provides for national, regional, state, and local standards and criteria for air quality and pollutant tolerances which must be observed in all coal and energy conversion operations.

In addition, judicial interpretations of the Clean Air Act require that where ambient air quality is already cleaner than required by the national standards, any "significant deterioration" of such air quality must be prevented. This will have particular relevance where mine mouth power plants are contemplated in such areas.

Cultural, historic, archeologic and paleontologic resources on Federal land are protected under the Antiquities Act of 1906 (34 Stat. 225) and the Historic Site Act of 1935 (49 Stat. 666). Of special note in the protection of historic and archeologic values on Federally administered lands is the Historic Preservations Act of 1966 (80 Stat. 915); whereby all actions that will impact on the cultural resources must be reviewed by the Presidential Advisory Council on Historic Preservation prior to their implementation. Executive order 11593 directs preservation of historic values. These and other Federal statutes afford varying degrees of protection by requiring the identification, evaluation, and protection of historic cultural resources that would be impacted by coal operations and energy conversion.

An extensive list of Federal statutes affecting coal operations is given in Part I of this statement. Many of these will serve as s stimulus for the development of new techniques to reduce the environmental impacts of coal extraction and utilization.

State laws vary widely in regulating various aspects of coal operation and are far too numerous to list here. Some are strict as to extraction of coal and requirements for controlling surface and subsurface mining practices. 30 CFR 211 applies to all operations on Federal coal leases regardless of State law. If State laws are more stringent than the Federal regulations, State laws are used in lieu of the Federal regulations for operations on Federal lands. Supervision remains under the Area Mining Supervisor and BLM regardless of whether Federal regulations or State laws are being applied. Where not in conflict with Federal law, state laws dealing with coal operations have usually been allowed to govern in exploration, development, production, abandonment, and use of coal as a prime energy source. New legal determinations of precedence will be needed, if and when variances arise between Federal laws and regulations relative to coal operation and those existing in the different states.

Regulations

Surface management procedures are similar for the Bureau of Land Management and the Forest Service. Both are primarily concerned with the protection of surface resources. Regulations enforced by the Geological Survey are directed towards protection of the surface and subsurface resources for maximum efficiency, and recovery of coal. These apply only to leaseable mineral operations on Federal lands and are concerned with conservation of resources, protection of the environment, protection of public health and safety at the operation, and royalty accounting.

BLM regulations having a bearing on coal mining environmental impacts include: bonds, stipulations, and adequate Federal administration.

Bonds: 43 CFR 3504

Appropriate bond must be furnished by the lessee prior to commencing operations. These range from a minimum of $1,000 for coal on a single lease to $25,000 for a statewide or $75,000 for a nationwide operating bond for all coal leases or permits. Normally, bonds always exceed the minimum required. These compliance bonds are held until the satisfactory completion of required rehabilitation measures. Additionally, different states have their own bonding requirements, usually set at so much bond money per acre of land disturbed and reclaimed.

Forest Service regulations pertaining to offsite aspects of coal leasing are included under the general conditions for special use permits in 36 CFR 251. These regulations, Forest Service Manual instruction, and the special use application and report which they require are found in Appendix E.

Stipulations

Under proposed revisons of 43 CFR 23, Appendix D, stipulations are prepared prior to issuance of coal leases and permits or continuances of existing leases. Often at the time of issuance or continuance there is insufficient information about proposed operations to assure stipulation will cover all problem areas. Therefore, when an operations plan is subsequently submitted, stipulations are reviewed and revised or added to make them fit the specific situation as closely as possible. Inclusion of stipulations in the plan approval stage assures environmental protection on older leases issued prior to use of stipulations as part of the lease contract. Multi-discipline, interagency teams draw up stipulations in all cases. Local government and public input is encouraged. Stipulations can be broken into 16 categories on the basis of their major areas of application as follows:

1. General
2. Ecology
3. Roads and Trails
4. Erosion Control and Surface Rehabilitation
5. Aesthetic, Scenic Values and Natural Beauty
6. Air Pollution Control
7. Water Pollution Control
8. Hazardous Substances Pollution Control
9. Solid Waste Disposal
10. Noise Pollution
11. Pipelines and Utilities
12. Wildlife
13. Timber and Other Vegetation Materials
14. Mineral Values
15. Antiquities and Objects of Historical or Scientific Interest
16. Employee and Public Safety

Stipulations used in four actual coal leases are in Appendix G. The sample stipulation list from BLM Manual 3509, "Surface Management Requirements for Exploration, Mining and Exploration (Mineral Leasing Acts)," is shown as Appendix H. Stipulations for coal lands under jurisdiction of Department of Agriculture are in Appendix I.

The standard Federal Coal Lease (Form 3130-1, October, 1967) used by the Bureau of Land Management includes the following Section 5, Protection of the Surface, Natural Resources, and Improvements:

"The lessee agrees to take such reasonable steps as may be needed to prevent operations, including operation of operating plants on the leased premises, from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth on the leased lands or on Federal or non-Federal lands in the vicinity; (2) polluting air and water; (3) damaging crops, including forage, timber, or improvements of a surface owner; (4) damaging improvements whether owned by the United States or by its permittees or lessees; or (5) destroying, damaging, or removing fossils, historic or prehistoric ruins, or artifacts; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required and to the extent deemed necessary by the lessor to fill any sump holes, ditches, and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land and access roads to its former condition, including the re-

moval of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon, whether or not owned by the United States."

Section 5 or a section with similar content is in all leases and is the basic authority for modifying mining and reclamation plans to meet present surface protection requirements on older leases issued prior to 1969, the effective date of 43 CRF 23.

Detailed discussion of the use of stipulations to require actions which may lead to mitigating of environmental impacts will be given on an action by action basis. However, an abbreviated overview may first be helpful from an operations stage perspective, reviewing agency roles at each stage of coal leasing and mining as they apply.

Adequate Federal Administration

To assure the mitigation of environmental impacts, frequent surveillance of the mined area will be needed.

Under present regulations, BLM manages surface resources consistent with its multiple-use planning system. BLM conducts a field examination when a lease or prospecting permit application is filed. After the permit or lease is issued, the GS assumes operational management of the mining operation and inspects active leases at least three times a year and inactive leases once a year. Active permits are inspected twice a year and inactive permits, once a year. BLM may also conduct inspection within the lease area to assure that other surface resource uses are being adequately safeguarded in accordance with lease terms of stipulations. At termination, expiration or renewal of the lease or permit, BLM and GS conduct an examination to determine if the lease or permit stipulations have been fulfilled. Based on this report, the permit may be extended or the lease renewed. Normally no other inspection is made.

To prevent environmental impacts from becoming critical and irreversible, stringent inspection is needed.

To be effective, an on-site inspection should be conducted by an environmental specialist well versed in the applicable impacts factors. Inspections should be made on a non-scheduled basis when needed during active operations on a lease or permit, or period of reclamation. Whenever practical, the lease operator should be present during the inspection to ensure full understanding and compliance with the mining plan and lease or permit stipulations.

A further requirement is that the operator submit a comprehensive report of the reclamation steps taken to minimize the impact factors. In most cases, the rehabilitation will be concurrent with or follow closely the extraction phase. This enables the GS in the management function to be informed of all reclamation procedures needed to comply with approved exploration or mining plans. Copies of the reclamation report are submitted to BLM by GS for record, evaluation and subsequent approval. These reports are available for public inspection.

DETAILED SPECIFIC MITIGATING MEASURES

The remainder of this section lists all possible specific measures to mitigate impacts of the various parts of the described action.

Individual parts of the action may impact environmental components much the same as other parts. However, the degree or extent of the impact is usually different between actions. For instance, underground mine development impacts soils and vegetation less severely than does stripping. The area impacted is usually smaller. For this reason mitigating measures for impacts on soils and vegetation are discussed in detail under overburden — waste piles — settling ponds. Mitigating measures for impacts of underground mine development on soils and vegetation appear neglected. They will continue to appear neglected unless the remainder of this section is read as a whole and not as unrelated parts.

EXPLORATION

Off-road Travel

The permit for exploratory operation using off road vehicles (ORVs) should include:

- An approved route for ORV access to exploratory sites.
- An approved plan for rehabilitation of site damage by OVRs including damage by indiscriminate or unapproved use by permittee.

An access route to the exploratory sites should be selected by the federal agency involved, utilizing the responsible land manager and interdisciplinary team. The overriding factors in final route selection should be access to the desired drill sites by routings that will minimize environmental damage. These include:

1. Minimum visibility within scenic areas or from traveled routes.
2. Selecting routes parallel to contours and confined to land depressions when possible.
3. Utilization of existing access routes and disturbed areas.
4. Avoiding highly erosive terrain.
5. Avoiding travel on heavy soils when wet.
6. Avoiding travel on vegetated sandy soils when dry.

Other investigations are also required to determine impacts. A thorough research effort to identify and inventory historic resources (trails, event site, structures, etc.) in the area to be explored will be necessary in order to keep exploration activities off of and away from such resources. To facilitate such an inventory, a comprehensive area history should first be prepared.

Adherence to and enforcement of Federal and State laws and regulations, such as the Antiquities Act, Historic Sites Act, and the Historic Preservation Act; along with non-intrusion on the environs of historic resources, can reduce or minimize the impacts caused by exploration activity. Historic objects and sites revealed by exploration activities should be researched and evaluated prior to continuance of operations.

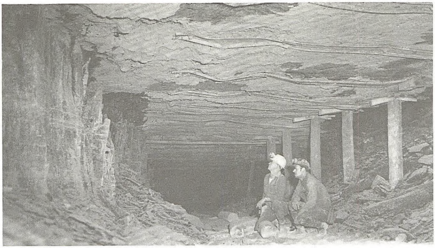
The team must consider the impact upon unique fish and wildlife situations, especially if drainages must be crossed and wildlife habitats might suffer. Sensitive vegetative areas should be avoided. Damage to plant root systems and top growth should be minimized to assure reestablishment of

plant cover. Cutting of vegetation should be avoided for ORV access, if possible. Any vegetation destroyed should be reestablished as outlined under overburden-waste piles-settling ponds.

Time and method stipulations for travel can be incorporated into the prospecting permit which will mitigate most wildlife impacts. Crucial habitat areas can be avoided during times of critical nesting, breeding, wintering, etc.

After all investigations, the proposed ORV route should be staked by the agency. The access should be reviewed in the field with the applicant so all potential conflicts can be resolved prior to issuance of the permit. Frequent inspections by the agency will help to assure compliance with the permit. Failure on the part of the permittee to adhere to the stipulations should be grounds for revocation of the permit.

Both the Federal Aviation Administration and the State Game Commission can establish minimum aircraft flight elevations over waterfowl refuges and other critical wildlife areas (USDI, BLM, Preliminary Onshore Oil and Gas Environmental Statement currently being finalized for draft release).



Lower seam of multiple seam mining operation near Summerset, Colorado.

Drilling

Measures to mitigate damages or actions resulting from drilling are as follows:

1. Leave the vegetation on the drill site or pad.
2. If grading is necessary at a drill site, return the site to the natural grade, with the same topsoil and reestablish the native vegetaion.
3. Promptly plug drill holes and scatter drill cuttings. If drill cuttings contain toxic minerals in quantity, keep them away from water bodies. Dispose of by burial deep enough to avoid leaching.
4. Promptly seal all aquifers penetrated if they contain undesirable water.
5. If good water is available in a drill hole and it is needed in the area, insure that it is properly used, transported and does not create erosional or other problems.
6. Encourage companies to do development drilling with exchange of data so data would be available to all interested parties at no cost to the public. This would resolve the need for competitive companies to drill the same area with consequent added environmental impact.
7. Restrict drilling on steep slopes or highly erosive soils where permanent damage could result.
8. Take advantage of natural benches, rims or other level areas.
9. Restrict surface occupancy when drilling will significantly damage other resource values.

Excavations

The excavations referred to in this section are only those trenches and pits dug for the exploration of coal.

Prior to issuance of an exploration permit, seek the surface owner's or land manager's suggestions for future utility of the pits and his recommendations for rehabilitation of the disturbed land. Measures to mitigate the resulting environmental impacts include:

1. If the pits are to be closed:
   a. Restrict size of pits.

Miners placing crossbars against the roof for support. This is the Loveridge mine near Fairmount, West Virginia.

Hazardous areas should be fenced against people and animals.

b. Store top soil separately from the lower soil horizons and replace as soon as pit exploration is completed.
2. If pit is to be left open:
   a. Shape excavated material, and pit side walls to either a 4:1 or 3:1 slope depending on size of pit. Replace top soil.
   b. Seal coal seams, contaminated soil areas and permeable strata to insure water quality and volume to meet planned use standards.
3. In all cases construct erosion control measures as needed and revegetate disturbed areas.

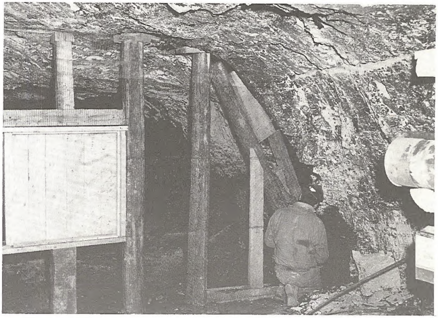
DEVELOPMENT AND OPERATION

Underground Mines

Possibly the most serious problem resulting from underground mining is subsidence. Deep mining will minimize the surface effects of subsidence. Subsidence can be controlled in some degree by backfilling with waste, fly ash, sand and gravel or other suitable material. Not only does this help fill the void, but it may reduce surface disposal requirements. Research is being done by the Bureau of Mines in Wyoming and Pennsylvania to pump material underground to stabilize urban developments constructed over underground coal mines. Another method to control subsidence is to cause the underground mined area to collapse uniformly or at a predetermined rate. This will reduce holes, cracks, and other hazards and permit rehabilitation at the earliest possible time. Blasting can be used to induce systematic caving. This may work in undeveloped areas but it can cause major problems under towns, roads, reservoirs, etc. A third mitigating measure is to leave adequate support in the mined area so that the roof does not collapse. This method may leave large reserves of coal unmined. Deterioration of natural pillars will ultimately lead to failure, collapse, and surface subsidence. Another alternative is not to mine coal by underground methods where subsidence can be a problem. If subsidence is a problem and the coal seam is within economic limits of surface mining, strip mining can prevent this problem. Subsidence should be a consideration in developing an underground mine plan. Do not mine where subsidence would eliminate an endangered animal species. Hazardous areas should, if possible, be fenced against people and animals.

Waste material from underground mines is further treated in the section on overburden, waste pits, and settling ponds. Another major problem from underground mines is waste water. In mines where water is a problem, they can be sealed so that they do not drain into the surface water. Treatment facilities can be built to neutralize mine drainage (Spaulding and Ogden, 1968). Limestone or calcium oxide can be added to acid waters. Iron hydroxide produced in acid mine waters is an effective absorbent for many trace elements. Subsequent removal of the iron hydroxide is an effective way to remove many of the trace elements.

Contamination of underground aquifers can be mitigated by keeping the mines pumped out. Care should be taken not to fracture the beds next to the coal seam to prevent the mine water in mines where this water is



All shafts, drifts, or portals that are no longer used are sealed or caved in to prevent people, wildlife, or domestic animals from entering an unsafe situation.

contaminated from mixing with other aquifers after the mine is abandoned. The walls of mine shafts could be grouted or suitably sealed where water seepage is a problem. The seal should also prevent leakage between aquifers penetrated by the shaft. A further discussion of protection of aquifers will be found under overburden, waste piles, and settling ponds.

All abandoned shafts, drifts, or portals are required to be sealed or caved in to prevent people, wildlife or domestic animals from entering an unsafe situation. Any holes or pits caused by subsidence should also be safely covered.

Federal safety regulations require proper sealing and fire fighting plans. Government engineers are responsible for safe working conditions underground. All underground mining operations are regularly examined.

To mitigate or prevent fires in coal storage piles the coal should be layered and compacted with gentle side slopes. Conical piles tend to develop spontaneous heating (Paulson, et al., 1973).

In some situations other mineral values besides coal must be considered. Underground coal mining should be done in such a manner to protect and allow development of other minerals. Some mitigaing factors would include:

1. Providing maps of all underground mines showing depth, size, and direction of opening, type of mining used, whether or not the roof had collapsed and the date of mining.
2. Other information from underground mines should include the structure, type of rock, stability and any other known mineral values.

This data would help identify other mineral values and promote the safety of other mining operations within an area.

The visual impact of mine mouth portals can be mitigated to a certain extent by selecting a site away from public roads. If the portal cannot be moved, it can be made to blend with the surroundings. In developing new portal access the esthetic impact on the surrounding area should receive consideration along with the best grade, site or shipping point. If old portals cannot be moved, they can be screened and have trash, old buildings and waste material cleaned up around them.

To mitigate archeological impacts refer to section on overburden, waste piles, and settling ponds.

Minor impacts of undergound mining upon topography, soils, vegetation, wildlife, timber production, recreation, historic and geologic human interest values can be mitigated by appropriate techniques discussed in the following section.

Overburden-Waste Piles-Settling Ponds Both Surface and Underground Mines

Geology. Coal fires would change the geology of an area. Adequate placement and compaction of earth cover over all exposed coal faces will exclude air and prevent ignition and burning. Proper construction and drainage associated with waste ponds must be considered to avoid danger of massive slides or major washouts, such as those that occurred in Buffalo Creek, West Virginia.

Topography. Impacts affecting topography are directly related to those impacts on hydrology, soils, vegetation, wildlife, ultimate land uses and aesthetics. Mitigation measures will be subsequently discussed as appropriate.

Climatology. Revegetation should follow mining as quickly as possible to reduce dust in the air and to restore an erosion resistant surface. To prevent blowing of the fine material from waste piles and settling ponds, sprinkle with water.

Fires in waste piles can best be avoided by first spreading and compacting any waste with a high coal content. Such compacted layers should be covered with compacted dirt. Once a fire is burning, it can best be put out by digging it out and spreading the burning and hot unburned fuel. This, in effect, cools it to the point where burning ceases. In some cases water will further cool and take away the oxygen necessary for combustion.

Hydrology. Waste piles, coal storage piles and settling ponds must be located so they can't be washed away.

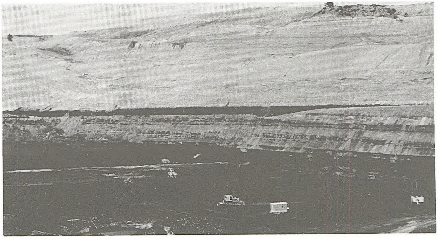
If drainage or seepage will be a problem, the surface beneath sites of waste piles, coal storage piles and settling ponds should be stripped of topsoil, which is to be stored for later use. It should then be made impermeable by treating with bentonite or other sealant.

Waste or coal storage piles should be surrounded by berms and drainage from them and from mines as well routed through the settling pond. Berms and ponds should be big enough to handle maximum intensity of a 100 year storm. Sometimes underdrains are necessary to protect surface water.

Refer back to underground mining for measures to mitigate mine water pollution problems.

Route run-off around disturbed and operating areas. Culverts may be needed to reduce erosion while moving this water.

Results from mitigating potential sedimentation and pollution problems should be monitored. Changes in methods must be made if necessary.



Two seams were mined at the Big Horn No. 2 near Sherdian, Wyoming.

Mixing or disruption of subsurface aquifers can be mitigated by avoiding those of special importance to an area. These important aquifers can be identified only by advance drilling studies which determine the quality and quantity of their yield and the existing or potential uses dependent on them. Once disturbed by surface mining, they cannot be reestablished, although water from them might be salvaged and put to use.

In the west, where salinity in soils and water could be a problem, mine drainage and waste water may have to be contained as previously discussed. Water can then be disposed of by evaporation or its quality improved by desalting or dilution.

Good quality water can be stored during periods of high run-off to use to dilute poor quality water released to streams during periods of low run off. This does not solve the total problem but makes the impact less significant at any given time. This method should not be applied to the Colorado River drainage.

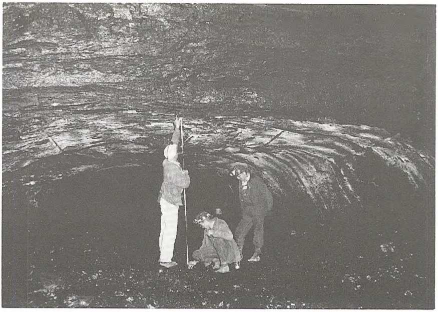
Injection of poor quality waste water into poor quality underground aquifers is possible where hydrologic studies indicate the feasibility.

Trace minerals and dissolved solids may be removed by iron or aluminum flocculants or membrane filtration. Research is underway to determine more efficient methods to remove them.

Warm mine waters in Alaska should be stored in ponds to cool and should be released to streams during high run-off.

Below the disturbed areas at mines, washing plants, and stripping and open pit operations, sediment traps sufficient to handle 100 year storms should be built.

Soils and Vegetation. Techniques for revegetating spoil banks in the East have been generally agreed upon "... we know reasonably well what species will or will not grow, where they will grow, what they require to make them grow and their effective use for reclamation purposes. We also know that 90 percent or more of the spoil areas in the Northeast will support vegetative growth sufficient to stabilize spoil areas..." (Ruffner, 1973).



Natural arch left after coal mining.

Ruffner excepted steep unstable areas, erosive areas with water improperly disposed of, and acid or toxic spoils.

Mining must be limited to slopes on which slides are unlikely to occur. Acceptable slopes depend on ability of spoils to resist shearing stress and other factors, including the mechanical and physical characteristics of the surface on which they are placed (Williams, George P., Jr., 1973).

In the wetter coal provinces and wetter biomes or portions of biomes in other provinces, vegetation can generally be re-established.

Experience in West Germany, where lignite mining causes re-location of entire communities, shows the benefit of removing topsoil and later replacing it for agricultural or forest production. With the coal industry nationalized since 1947 in the United Kingdom, topsoil, subsoil, and overburden are treated separately, and mined land is restored to productive use (Council on Environmental Quality – 1973).

Coupled with experience and knowledge already existing in the United States, restoration of mined lands under sub-humid conditions seems likely. This is in spite of the fact that in a national study of 689 sites in the United States, effective plant cover had been established on only about 29 percent, cover was inadequate on 53 percent, and 18 percent were unsuited to plant growth (Ruffner, 1973).

In the drier biomes of the semi-arid and arid West, rehabilitation is still in an experimental stage. There are many "unanswered questions about revegetation in the far West. None of the land reclamation projects has continued for sufficient time to demonstrate that the vegetation will be successful" (Council on Environmental Quality – 1973).

"No significant progress has been made in revegetating reclaimed strip-mined areas at the relatively arid Black Mesa and Navajo sites. Strip mining reclamation for semi-arid areas is in an experimental stage" (USDI Study Management Team, 1972). Natural vegetation was very sparse.

Of great importance in the West, but of help in the East, would be strip mining, where practical, in a northeast-southwest direction. This would align soil piles to expose the least amount of surface to the south and west. South and west slopes are more difficult to grow plants on because they are hotter and drier.

Measures to mitigate the impact on soils and vegetation from overburden removal and stockpiling must be planned before mining commences. Core drillings of overburden materials

need to be analyzed by stratigraphy or depth classes for physical characteristics capability of weathering into soil size particles (Brube et al., 1973). Analyses should also be made for essential plant nutrients and toxic materials. Sodium is a primary problem in the West. Acidity is the primary problem in the East. Local experience is needed to determine which quantitative tests are needed. An intensive soil inventory of the area to be disturbed is required prior to any disturbance. Soil inventories must include enough laboratory data on chemical and physical soil properties so intelligent decisions may be made concerning the soils resource both on-site and on affected off-site areas. Tables of soil characteristics, uses, and limitations are included in descriptions of the environment.

The ultimate goal is to restore vegetation on disturbed areas. The importance of doing this is brought out by the statement: area mining in the far West may well be unacceptable unless vegetation can be re-established.

Minimizing the area on which soils are disturbed and vegetation destroyed is of primary importance.

Four actions absolutely necessary to protect soils during and to successfully re-establish vegetation after mining are:

1. Stockpiling of the upper stratas with separation of topsoil.
2. Shaping soil or waste piles to simulate natural topography, including backfilling the last area mined to reduce the high wall, re-establishing natural drainage ways, and eliminating steep slopes.
3. Re-distributing topsoil over the spoil piles.
4. Protecting the area from erosive forces of wind and rain.

Sindelar, Hodder, and Majerus (1973) reported that replacement of topsoil can significantly increase establishment and production of vegetative cover on reshaped mine spoils. They also state, "Many materials may function as substrata for plant growth by acting as a nutrient and moisture pool and by providing mechanical support for plants. Overburden of satisfactory texture and chemical and physical properties may serve as a suitable growth medium for vegetation with replacement of plant nutrients as they are used. But many other manipulations and modifications of overburden are necessary to produce a life support system for permanent plant communities of surface mined lands."

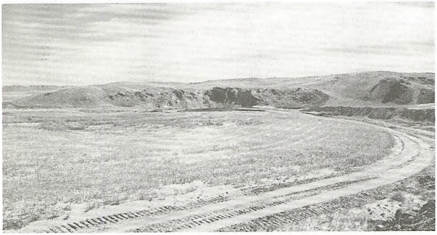
They reported in Montana that between four and eight inches of topsoil redistributed on a 3:1 slope were adequate.

Sutton (1973) and Hodder (1973) support the practice of putting topsoil back on top if it exists to begin with.

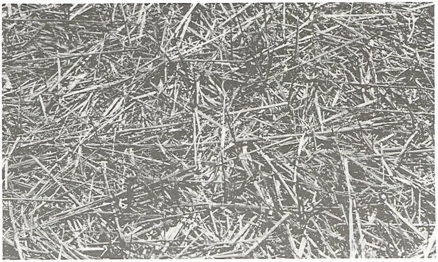
Moving topsoil from another area is not acceptable if either area will then be unable to support enough vegetation to protect the area against erosion. Guard against leaching (by percolation) of greater-than-normal amounts of toxic material on both areas.

Topsoil should be placed in its final position as soon as possible after its removal. Rapid replacement will take advantage of any live native seed or root stocks it contains. If not used within a year, stored stopsoils should be revegetated or otherwise protected against loss due to wind or water erosion.

Populations of soil microorganisms fluctuate very rapidly (Russell, 1950).



Where practicable, topsoil should be stripped from the site and stockpiled for replacement after work has been completed and the area is ready for rehabilitation. Sorghum ranging up to 2 feet high was grown without irrigation on reclaimed soil in this test plot at the new Belle Ayr mine of Amax Coal Company, about 10 miles south of Gillette, Wyoming.



Topsoil stockpiles should be seeded, mulched or covered to prevent soil erosion if they are to remain over a winter season.

They may fluctuate as much as 40 million per gram of soil within a 24-hour period. Proper use, handling, and storage of chemicals can minimize spillage which harms soil organisms. Incorporating organic materials, especially litter and manure, in the re-distributed topsoil will accelerate soil organism population growth.

Knowledge is very limited as to the fate of soil organisms during mining operations. Some research is presently underway in England but results are not available.

In the West where topsoil may not exist or it and subsoil are too thin to allow early re-vegetation, the next best thing is to bury the commonly occurring fine textured, saline and/or sodic earth material (Hodder, 1973). Suitable covering material may occur somewhere in overburden profile.

Problem materials are usually found in greater quantity with increasing depth (Sandoval, et al., 1973).

Sandoval, Bond, Power and Willis (1973) surmised, for fine textured sodic spoil materials, that a period of several years might be required for adequate rehabilitation. They suggested that the sodic conditions may be overcome by applying gypsum and leaching the sodium so it is below the rooting zone or redistributing the topsoil. Sindelar, et al., 1973, are currently studying the possibilities of having a buffer material between extremely adverse spoil and topsoil. Results from these studies are not available. They are trying to stop upward movement of salt in spoil banks. Such movement has plagued many western irrigation projects.

Acid soils, more common in the East, or any other spoil material unsuitable for plant growth must also be buried below rooting depth.

Placing light-colored material, if suitable for plant growth, on top would reduce soil surface temperature and aid in growing plants (Sutton, 1973).

Soil and spoil material require certain properties favorable for plant growth before complete rehabilitation can be achieved.

Acidity may be treated by adding lime. The lime equivalent needs to be known as large amounts of lime could be required initially and at regular succeeding intervals to maintain the desired pH level. Vogel, 1972, suggests that one treatment of acid layers that cannot be buried properly is to leave them in situ. That is – not mined.

Neutralization of acid spoils is possible with the addition of alkaline fly ash which may also contain boron, phosphorus, and zinc that are necessary for plant growth. Fly ash may also improve soil texture (Capp and Gilmore, 1973).

Addition of sewage sludge or manure can neutralize acid or alkaline soils, or spoils, improve structure and water holding capacity, and provide plant nutrients (Dean and Havens, 1971; Gordon, 1969; Peterson and Gschwind, 1973; Sutton, 1973; Sapper and Mardos, 1972). Sutton, 1973, states, "Several years will be required before there will be enough improvement in the untreated portion (below zone of mixing of spoil with sewage sludge, manure or limestone or below a topsoil layer) of highly pyritic spoils to support plant roots."

As with fly ash, sewage sludge and manure must be tilled into the soil or spoil and growth of roots is initially limited to the depth of mixing.

Mixing of sewage sludge, manure, or other material high in organic matter apparently is not as acceptable as replacement of topsoil.

"A test plot using variable depth of topsoil on a 3:1 slope at Western Energy Co.'s mine, Colstrip, Mont." Even-numbered plots (2, 4, and 6) were planted on raw spoil, and plots 1, 3, 5 and 7 were covered with 4, 8, 8, and 2 inches of topsoil, respectively.

Graded spoil-bank should be revegetated or otherwise protected against wind and water erosion.

Slopes or re-shaped spoils and waste should not exceed 33% in wetter provinces and biomes. In pinon-juniper and areas with less than 8 inches annual precipitation, northeast and southeast facing slopes should not exceed 20% and 25% respectively (U.S.E.P.A. 1972).

Steep slopes on the periphery of the spoil bank area are very conducive to erosion by rills, gullies, or mass movement. Wischmeier and Smith, 1965, have shown that water erosion is influenced exponentially (1.4 power) by slope. The S (slope) factor in their erosion formula is 5.38 for a 30% slope, 8.10 for a 40% slope, and 14.2 for a 60% slope. One may see that steep peripherial slopes have tremendous potential to be the source of erosion and subsequent off-site sedimentation. Sindelar, et al., 1973, reported that no serious difficulties were experienced in stabilizing topsoil on a 40% gradient, but tilling and seeding with farm machinery were impossible. Kentucky's mined land reclamation law requires the operator to backfill to the top of the highwall and grade to original contour, eliminate spoil peaks, bury acid forming materials and revegetate.

Surface configuration of the reshaped spoil banks was shown by Sindelar, et al, 1973, to be very important in the west. They reported a distinct advantage in manipulating the surface of shaped areas into configurations which limit runoff and encourage infiltration of precipitation. The most efficient treatment was gouging on the contour. Gouged basins trapped sediment and snow, reduced runoff, and aided in moisture storage within the materials.

Reshaped spoil areas that are compacted by equipment to such a degree that root penetration or permeability is seriously affected should be chiseled to an adequate depth to permit revegetation.

Tabler (1973) has found that properly designed snow fences can retain most of the moisture coming as snow. Thus, at Kemmerer, Wyoming, more than 4.5 inches out of a total of 9 inches of precipitation coming annually could be retained.

Surface has been prepared and seeded on the contour to limit runoff.

In the East, mechanical methods for keeping moisture on a disturbed area to help get plant growth started include "seed ledges" and "furrow grading" (Riley, 1973; Jones, et al., 1973).

Potential water erosion from spoil areas or rehabilitated areas may be calculated before mining by knowing the characteristics of the overburden and how it is to be reshaped (Wischmeir and Smith, 1965; Wischmeir, Johnson, and Cross, 1971; and USDA, 1972). The amount of protection needed for a defined level of erosion must then be determined. This protection may be provided by vegetation, redistribution of desert pavement or spoil boulders or artificial cover. In the most arid areas, hard surfacing of spoils might be studied. Such surfaces create artificial watersheds. They could yield water of extremely high quality. Maintenance requirements would be perpetual. If caught in covered reservoirs immediately downstream, loss through evaporation could be minimized. Research into such a technique would require complete environmental and benefit-cost analysis.

Drainage problems involving surface water can be lessened by directing water around the disturbed area, but

Erosion from spoil areas may be reduced knowing the characteristics of the overburden before mining.

Shaping spoil or waste piles to simulate natural topography, including backfilling the last area mined, re-establishes natural drainage ways and eliminates steep slopes.

such action must not create new problems. The new drainageways must be able to handle the water and remain stable.

Potential wind erosion cannot be quantified like water erosion at this time. Wind erosion is quite significant, especially on sandy soils. Nielson and Peterson, 1972, reported that chemical binding agents on areas susceptible to wind erosion have been used with good short term results. Long term results are not known. Soils tables in Section II identify some soil series which have a severe or very severe wind erosion hazard. Soils identified as such usually have sandy loam or sand surface textures.

To reduce or eliminate off-site problems caused by coal mining, several methods can be used. For strip mining on slopes, dikes below the disturbed area can confine any waters poisonous to vegetation. To serve the same purpose in flatter areas, berms can be used (Peterson and Gschwind, 1973).

To eliminate the possible overfertilization of downstream waters and related effects on plants, "nutrient barriers" (dense vegetation surrounding disturbed areas) may prove beneficial (Peterson and Gschwind, 1973).

Area needs protection from erosive forces of wind and water.

Use of flocculants in settling ponds may be necessary to control sedimentation (McCarthy, 1973).

In addition, for acceptable re-establishment of vegetation:

1. Collect base-line data describing the quantity and quality of vegetation before disturbance.
2. Select desirable plants which will grow permanently in the environment.
3. Nourish and care for the plants until they can sustain themselves while not receiving more care than adjacent vegetation.

Baseline data will serve as a possible target during rehabilitation and can be used to finally measure what has been lost or gained as a result of coal mining.

Selection of plants to be grown is especially important in the semiarid and arid west. Native species, even ecotypes (plants from the particular location), can prove more successful than plants from more distant areas (Ward, 1969).

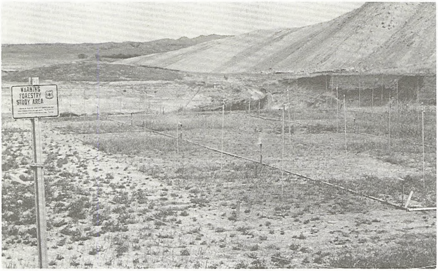
Northeast and southwest facing spoil slopes require different kinds of plants and different amounts of seed.

Mixtures of grass, forbs, and brush should be used to avoid the hazard of monocultures (plants of only one kind growing in an area). Experience with serious pest attacks in wheat, corn, black locust, etc., should provide the lesson. Use of many species can be a form of natural biological pest control, (Knight, 1969).

Brush is of value for its windbreak, snow fence and shading effects.

Revegetating waste piles and settling ponds can be very difficult. They must be covered with topsoil if they contain toxic substances. Placing a buffer material between the piles or ponds and topsoil could be beneficial. However, research is not complete enough to draw conclusions (Sindelar, et al., 1973). Wind erosion from dried up settling ponds may be reduced by applying chemical agents which bond the particles. Mulches and boulders may also be utilized for controlling wind erosion.

All seeding should include dryland alfalfa or some other plant that can fix nitrogen naturally in the soil. Any



Base line data will serve as a possible target during rehabilitation. This test plot at the Decker mine in Montana will determine the most desireable vegetation for the area.

legume seed should be innoculated with the correct species of micorrhizal fungi before sowing.

The roots of different plants also use the soil differently. Grasses are relatively shallow rooted (18″-24″) while forbs and brush can have shallow roots and also have more roots extending to much greater depths. Thus, a variety of plants uses an area more completely. At least some are likely to survive under a wide range of weather conditions.

Sindelar, et al., 1973, are conducting rehabilitation experiments using a wide variety of native and exotic grasses, forbs, and brush.

Use of pioneer (nurse) crops may be beneficial. In semi-arid areas, they may hurt chances of establishing permanent vegetation cover (Thirgood, 1973).

Time of seeding to best use natural moisture as it comes is also important. This is particularly important in semi-arid western regions and recommended times for seeding are: Northern Great Plains – late fall or early spring; Southwest – late summer; and Intermountain Colorado, Utah, and Wyoming – fall, just prior to first snows.

Seeds should be placed at the proper depth. Soil coverage is highly desirable but various mulches provide a substitute.

Cook, et al. (1970) stated that for seed to grow, it must be kept constantly moist (not wet) for two to three weeks.

Mulches are effective agents to reduce wind and water erosion hazard, slow surface evaporation, conserve soil moisture, and reduce soil temperature. Sindelar, et al., 1973, reported that disced in straw makes an excellent mulch. There are commercial mulches on the market that may be sprayed on the surface. There are mats made of various materials which also may be used for the above-mentioned purposes. Local knowledge of soil, climate and vegetative requirements is needed to determine if and what kind of mulches may be beneficial.

Coal mine spoils in the U.S. are universally low in nitrogen and phosphorous and where acid conditions exist aluminum and manganese toxicity may be expected (Berg and May, 1969; Berg and Vogel, 1968; Sandoval, et al., 1973, and Sindelar, et al., 1973). However, where overburden is blasted with ammonium nitrate, soils may not be deficient in nitrogen.

To establish seedlings will require some artificial fertilization usually with nitrogen and phosphorus, and irrigation. Neither of these artificial aids to re-vegetation can be continued indefinitely but must be withdrawn slowly until the new vegetation can survive under natural conditions. However, nitrogen and phosphorus fertilizing programs *must include maintenance applications* following the initial applications to perpetuate the desired vegetative cover.

Artificial fertilizer must be used with care to avoid the possibility of its contaminating downstream water (Porter, 1969).

Protection of rehabilitation efforts from too heavy use by livestock, rodents, deer, and other plant eaters requires special effort, but is essential to prevent destruction.

Fencing against larger animals may be necessary. Use of thorny or badtasting plants may reduce animal damage.

Selection of plants to be grown is especially important in the semi-arid and arid west. Test plots such as this one can help preplan rehabilitation.

Particularly on small areas, 200 acres or less, plants that are especially liked by any one or several kinds of animals may soon be killed out.

Repellants which successfully ward off animals until vegetation becomes established are not available.

Once vegetation has been re-established, it must be properly managed (along with surrounding areas) to keep it growing. This is especially important in semi-arid western areas but also true in the sub-humid east (Thirgood, 1973; Heine and Guckert, 1973; Higgins, 1973).

A follow-up schedule for treatments is needed if reclamation of disturbed areas is to remain at its optimum.

From available information, likely conclusions are that:

1. In desert areas with 10 inches or less of precipitation or areas with sodic soils, revegetation may be impossible, and the only reclamation will be to restore the original hydrologic conditions and minimize the off-site effects of erosion.
2. In foothill type lands, cold desert of the desert biome and pinon-juniper of the woodland-bushland biome, with 9-18 inches of precipitation, (30-40 percent as snow) successes will be few without every precautionary measure. During drought, failure is nearly certain. South and west slopes will be extremely difficult to revegetate.

Many mining companies are conducting rehabilitation experiments using a wide variety of native and exotic grasses, forbs, and brush.

3. In the drier portion of the grassland biome, within the Northern Great Plains, low organic matter in the soil and high sodium levels in marine shales will require particular attention if revegetation is to be successful.
4. In sub-humid areas, proper application of appropriate mitigating measures discussed above, will in most cases, assure successful rehabilitation.

For semi-arid lands, revegetation may require effort for ten years or longer.

Test planting of trees, shrubs, four wing salt bush and squirrel tail.

Wildlife. Where surface mining would destroy or render unusable large acreages of big game winter range, the impact can be mitigated only to the extent that the habitat can be avoided or rehabilitated. Potential long-term loss of crucial, herd-limiting big game winter range may justify withholding an area from leasing, especially if coal reserves of similar minability and less conflict are available within the same area or region. This can be considered mitigation on a broad scale. Stipulations in a lease or mining plan could require that parts of a lease not be surface mined or not be used for spoil storage, to reduce winter range losses.

Although rehabilitation of big game winter range has been successful in some areas, it can be expected to be least successful in areas of low wildlife use due to inherent low rainfall, poor soils and management problems (Plummer, Christensen and Mowson, 1968).

The habitat of threatened species should be excluded from leases or protected by special lease stipulations.

In order to mitigate the impacts of increased human pressure and increased access on game and fish populations more restrictive hunting and fishing regulations will probably be established.

Certain wildlife population and habitat rehabilitation efforts can be termed "mitigation" measures only in

the broad sense that they establish some forms of wildlife and habitat desirable to man in general. In this case, impacts on many species affected by surface mining may not be mitigated at all, but after mining, new habitats, new species and new population ratios in the impact area may be established. A threatened native species may still be lost, or a number of species or types of animals formerly present, may be missing from the fauna, but, from the broad viewpoint, their loss may have been mitigated by replacement with other species.

In this vein, aquatic habitats in the form of lakes are often created in surface mined areas. If properly designed, constructed and managed, these waters can provide good aquatic habitat for fish, waterfowl, amphibians, muskrats, and a variety of other species (Arata, 1959; Riley, 1954; Sheve, 1971).

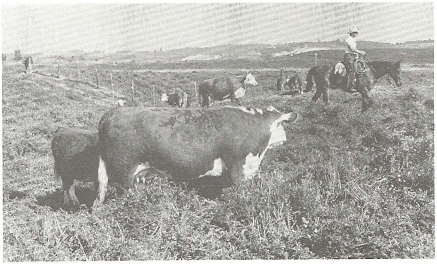
Intensive development, improvement and management for terrestrial species and habitats have also been very successful in some areas (Riley, 1954). This has been mostly in the deciduous forest areas of the midwest.

All surface disturbed areas not occupied by the mine facilities should be revegetated and shaped with proper drainage and erosion control structures, designed to minimize erosion and sediment pollution of downdrainage aquatic habitats. Plant species used in revegetation should be good food and cover species for native wildlife found in the area.

Loss of wildlife drinking water sources as a result of lowered water table, might be mitigated to some extent by constructing surface coater impoundments, obtaining good-quality water from deeper aquifers, where possible, or importing water from a distant source. Loss of springs in semiarid areas can be mitigated similarly.

Streams should not be channeled or relocated unless it it absolutely necessary to do so. Consultation should be encouraged with appropriate state agencies.

Long highwalls which could inhibit animal movements should be sloped and shaped at intervals to allow sufficient free natural passage and habitat utilization throughout the area. Occasionally tall stable highwalls in short lengths could be left standing to provide nesting sites for swallows, falcons, hawks and other birds.


To mitigate the adverse visual impacts of mined areas they should be shaped to form non-erosive gradients, natural drainage patterns should be reestablished to the extent possible. This reclaimed land is crownvetched near Cadiz, Ohio.

Aquatic wildlife habitat should be rehabilitated by improving water quality and restoring riparian vegetation. Silt and sediment movement through slower reaches of streams can be accelerated and directed by the use of in-stream devices, sediment collecstreambed loads can be stabilized and food production and spawning areas will be improved while further downstream damage is reduced (Spaulding and Ogden, 1968).

Restricting the timing for operations like exploration can reduce adverse impacts during critical periods like the breeding or nesting season.

Land Uses.

General. The best way to mitigate impacts of coal mining on land uses is to minimize the area of disturbance. If coal must be mined, it should first be done in areas of least rather than most


Spoil areas should be promptly revegetated to grasses, forbs, shrubs and trees.

Intensive development, improvement and management for terrestrial species and habitats has been very successful in some areas.

value for a given use. If a choice can be made, it should first be done on areas with values less necessary to society than others.

Stated in reverse, for example, grazing land should be mined before land producing truck crops. The poorest of the grazing land should be mined first and the smallest area possible should be disturbed. If the poorest grazing land has a high scenic value, the latter value may then dominate judgments.

Specific measures to mitigate impacts on particular land uses follow. Some uses will not be mentioned because nothing of significance can be added to what has already been said in this Section IV.

Timber. To least interfere with timber production, mine only where timber is ready for harvest. The period of time during which timber production is lost is then minimized to the time the site is occupied for mining plus the period necessary for reforestation. The same is not true for areas with non-marketable young tree growth.

Recreation. Loss of public recreational opportunity during site occupancy for mining could be made up by government purchase or acquisition by easement of similar opportunities on private land.

If mining physically displaces a recreation site, the impact may generally be mitigated through the relocation of that site to another area. Care should be exercised in providing a similar facility with equal recreational opportunities in the same general area. If the site is unique and mining operations would forever destroy the quality of the recreation experience, then mining activities should be avoided.

To minimize the impact of noise and odor, route heavy machinery and trucks away from recreation sites.

Wild Horses and Burros. What was just said for recreation can be said for wild horse and burro habitat.

A much larger acreage than that mined each year and promptly rehabilitated would need to be acquired. This is because these wild animals would be driven from an area much larger than that occupied at a given time or even during the life of the mine.

Livestock Grazing. Impacts on the production of forage for livestock can be mitigated by early plans to provide additional forage in other locations. The availability of water in alternate locations also must be assured if the animals were accustomed to drinking in the area mining is to occur. If alternate feed and water cannot be provided, the numbers of livestock using the area must be reduced to protect the environment, assuming that coal mining in that area has been determined to be the preeminent used.

Urban and Transportation Uses. Coal mining and urban uses are incompatible and coal mining will not be allowed. Where coal mining is done near transportation routes, efforts to reduce dust, noise, unsightly appearance, etc., will help mitigate adverse impacts.

Mining. Maximum efficiency in the removal of coal is a generally applicable mitigating measure. It reduces the amount of environmental disturbance necessary to produce a given amount of coal.

Mineral or material deposits in overburden, more valuable than coal, may preclude surface mining. They might be produced along with coal or handled by special means such as stockpiling to maintain their potential value. Each situation would have to be analyzed at the time an area is proposed for coal leasing.

To waste a minimum of coal, clean the surface of exposed coalbeds with care and keep all loose coal pushed up to the loading face.

All surface distrubed areas not occupied by mine facilities should be revegetated and shaped with proper drainage to minimize erosion and sediment pollution of down-drainage aquatic habitats. This is another large field of crownvetch near Cadiz, Ohio, in the left background is an area that has been surface mined and graded and is to be seeded to crownvetch.

To preserve coal still underground but too deep for further surface mining, cover exposed faces as previously discussed under geology.

Human-Value Resources.

Aesthetic, Scenic. If possible, mitigate impacts on scenery by avoiding that of outstanding beauty. Avoid wilderness areas. Avoid areas extremely difficult to revegetate such as highly erosive slopes, tundra and semiarid areas of less than 10 inches annual precipitation.

Avoid frequently seen areas, as along a major highway.

Select the mining method such as the modified block cut which least disturbs slopes. If necessary, fill the last excavation with spoil removed from the first or from the last several.

Shape spoil to the configuration required for final planned use. Use mining equipment if economical.

Blend the spoil area through a transition zone by rolling into the adjoining grade. Design and shape highwalls into the planned future use. Consider open space as one of these uses.

Reestablish drainage system and vegetation native to the area as quickly as possible. Follow mitigation procedures previously discussed under soils and vegetation.

Plant trees or brush near the base of any remnant highwalls in need of screening.

Historic. All mitigating measures described under Exploration and Underground mining apply to this subject. Since the impact on historic resources will in large measure be in proportion to the amount of surface disturbance, more extensive recording, salvage, excavation, and structure relocation may be required in surface mine development.

The impacts on historic resources of all on-site facility construction, mine operations and transportation facilities can best be mitigated by avoidance. Other measures can be taken to mitigate impacts in some degree, as described above in dealing with Exploration and Mine Development.

Geologic-paleontologic. Surface mining of coal should avoid all geologic features of high-value human interest to best mitigate environmental impact. Often this will not prove feasible, but should always be considered.

Keeping all loose coal pushed up to the loading face will increase recovery.

A degree of mitigation can be had by mining around surface features and restoring as nearly as possible the setting prior to mining. This will apply to features such as caverns, caves, geomorphic features, rock formations, badlands areas, and scenic viewpoints.

Of very high value and great importance are the paleontological values to be found in some of the coal provinces. As described in the Impacts section it would be very difficult to keep from destroying paleontological specimens in the overburden even if it were tried. A mitigating measure would be a paleontological survey prior to excavation for the purpose of determining the possibility of paleontological materials existing in the overburden. Initially this would be a search of published information. Certain formations indicate the right paleo-environment for fossil deposition and have been situated in a favorable geologic time horizon. Some of these strata are known to contain paleontological materials; they have been excavated and findings published. Certain areas and formations are more endowed than

Cleaning the surface of the exposed coal seam should be done with a minimum waste of coal.

others and the paleontologist will know what can be expected and where it *has* been found. From this and other information such as drill cores, the probability of paleontology values under a given area can be projected. This data gathering process will also involve field work by a survey crew. A miner trained in paleontology or contracted scientists should be available to salvage and preserve paleontological values unearthed during mining. Reports will be submitted and the materials remain federal property. Significant fossils are deposited in appropriate scientific institutions.

It was mentioned that fossils have the protection of the law in the Antiquities Act of 1906. The law provides penalties of up to $500 and 90 days in jail for persons damaging fossils. This is a mitigating measure and will be enforced. It is applicable to the person/company which does the damage and also to the federal land manager who allows it to happen. Solicitors opinions have placed vertebrate fossils on a higher order of value than invertebrates and plants but as the law reads now *ALL* fossils are protected by law.

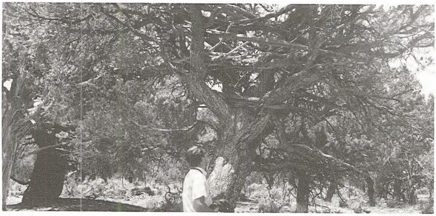
Should geologic features be on the National Register of Historic Places, or be eligible for nomination, a statement describing the action (in this case, coal leasing) must be submitted to the Advisory Council on Historic Preservation for comment. This is known as a "Section 106 statement" and must be submitted as directed in Section 106 of the Historic Preservation Act of 1966, Public Law 89-665.

Stone circle outline near Sheridan, Wyoming. These figures are thought to be ceremonial-religious structures of both prehistoric and historic Indians.

Archeologic. An archeological survey of the lands to be mined should have been made before the exploration phase was begun. Given that this has been done and all archeological values have been inventoried, tested, studied and evaluated, and, if needed, excavated, the only remaining mitigation would be to situate the mine in a location that would impact these values least and avoid them if possible. Archeological sites should not be excavated on a "must" basis. Ideally, an archeologist will have a problem to be solved or a particular area to explore in search of a certain set of information. He will then choose on which site in which area he will do this work, complete the survey or excavation, and publish on his findings. Often an archeologist will combine several seasons effort toward a major archeological work leading to proving or disproving, modifying, or developing an entirely new theory in archeology. Salvage archeology without proper recording techniques, would not be problem-oriented, and therefore, not necessarily contribute to the solution of a larger problem. All archeological sites should be left undisturbed until it is determined that the excavation of that site or sites can provide needed information.

If continued protection of these values in the immediate area of a mine is not practical, then the site should be excavated. Material would be inventoried and stored for later study and interpretation.

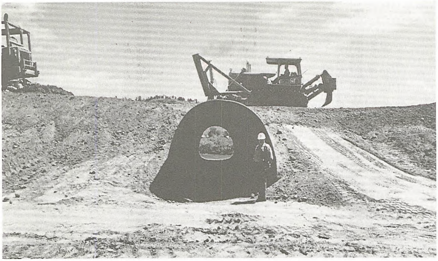
The antiquities Act of 1906 will protect archeological values and will be a mitigating measure if it is vigorously enforced. Also, if the archeological values are on the National Register of Historic Places or eligible for nomination, a 106 statement must be prepared and forwarded to the President's Advisory Council on Historic Preservation for comment.



All archaeological sites should be left undisturbed until it is determined whether the site can provide needed information. This is a scaffold burial site near Eagle, Colorado.

Facility Construction

Roads and Railroads. A master transportation plan should be required of the lessee as an integral part of the proposed mining operation prior to the issuance of the mining lease. The federal agency involved should utilize diverse technical skills in the analysis



Pre-planned road location, construction and maintenance practices with concern for stream protection will reduce siltation damage and future need for rehabilitation.

and approval of the proposed transportation system. An engineer and landscape architect should investigate and assist in location and design, along with specialists in mining, soils, vegetation and wildlife to focus on areas of critical terrestrial and aquatic habitat and other disturbances and possibilities for rehabilitation. Archeologists and historians may be required, if appropriate.

Pre-planned road location and construction practices with concern for stream protection will reduce interference with animal movements and the need for rehabilitation including follow-up maintenance. Adequate use of culverts, water bars, ditches, seeding, and bridge or culvert stream crossings will further protect aquatic habitat from siltation damage. Road culverts should be designed and installed to allow fish passage.

There are general guidelines which should be followed in road location, although there may be unique situations on a case by case basis. Adhering to the premise that mining is an interim activity, the affected agency should coordinate all road development with a comprehensive land use plan so that major mining access might serve multiple uses. Lease stipulations should include rehabilitation of all access that will not be retained for future use. Rehabilitation should include erosion protection such as road drainage, water bars, mulching and seeding.

The width of a road may affect mass wasting in addition to causing erosion. To prevent "over construction" of roads and railroad beds, the maximum acceptable road width should be identified. Every effort should be made to locate roads and railroads where there are no signs of active soil movement or slope instability. Short, steep pitches in road grade can be used when necessary to avoid zones of slope instability. Where a short section of road or railroad must traverse an area with signs of instability, plans should include design features which will reduce the potential for mass wasting.

Clues to potential mass movement are summarized as follows:

1. Soil wetness
   - Seeps, springs, and other areas where water is on the surface.
   - Presence of hydrophytes. Hydrophytes must be defined locally.
   - Meadows.
   - Black soils. These types of soils must be defined locally as having high water tables because many black soils are well drained.
   - Soils that are gleyed or mottled.
   - Small ponds of water located adjacent to an old slump escarpment (sag ponds).

   Soil wetness is very important because water tends to "float" the soil mantle, just as a person "floats" in a swimming pool. The soil mantle slides out of a wet area if a road cut removes the support just as water runs out of a swimming pool if a side is removed.
2. Areas where consolidated bedrock is more than about ten feet below the soil surface.
   - Fault Zones. Consolidated bedrock is ground and fractured by the faulting action.
   - Pockets of colluvium that have accumulated from previous erosion processes.
   - Any type of rock that is composed of hard fragments cemented by a finer grained matrix and the matrix is weathering into clay minerals. (Examples of this situation would be conglomerates, agglomerates, tuffs, shales and breccias that have undergone decomposition.)
   - Areas where the rock has weathered to great depths into soft materials that can be dug with a shovel.

   Consolidated, continuous bedrock close to the surface provides a sound foundation to support the soil mantle above an area of disturbance. Fractured, weathered, or deep bedrock does not provide support once the area is disturbed. Consequently, the soil mantle slides down the hillside. Cohesionless soils pose the greatest hazard for landsliding on areas described in this category.
3. Areas where the soil mantle is presently sliding
   - Tension cracks. This is where the soil mantle has cracked open as soil moves downhill away from soil that has stayed in place.
   - Hummocky hillsides. Usually occurs in plastic soils that are slowly moving downhill.
   - "Jackstrawed" or "crazy" trees. Trees tilted at different angles while having a straight trunk denote very recent soil movement.
   - Curved tree butts. The soil mantle has slid during the lifetime of the tree.
   - Depressions resulting from the displacement of withdrawal of material downslope.

Present sliding, as denoted by above clues, will be accelerated if the soil

mantle is disturbed. Many times clues listed under the first and second categories will be found in conjunction with those listed in the last category.

Precautions to reduce the potential for mass wasting may include, but are not limited to, the following items:

1. The road segment should be designed to the minimum width that will safely accommodate traffic and equipment for the intended uses.
2. Road and railroad location and design should be such that excavation will not remove support from the base of over-steepened slopes or remove the toe of previous slides.
3. Every effort should be made to avoid road locations in steep headwalls of drainages where sidecast of excavated material will increase the potential for mass wasting. If this is not possible, materials should be endhauled to a suitable disposal site.
4. Where compaction is desirable, fill material should be compacted in 6 to 12-inch lifts to a uniform density within 95% of maximum as described by the AASHO T-99 at a moisture content as deterimined to be suitable.
5. Perforated pipe should be installed in road ditches where groundwater is contributing to a slope instability. Enclose perforated pipe in a gravel filter and cover with gravel and coarse rock to protect the pipe from road traffic, to help prevent siltation of the pipe, and to support the base of the cut slope.
6. Flow and dissipation of energy of water from culvert outfalls should be carefully controlled. Where half-rounds or other conduits are used, they should be bolted to the culvert and firmly staked to the slope. Conduits should discharge water onto rocks or other dissipators.
7. Roads that will have use over a prolonged period should be surfaced and maintained adequately. Material should not be removed from stream channels, for road surfacing or any other purpose, unless a permit is obtained by the lessee from the appropriate state agency, and a satisfactory plan to protect aquatic life and prevent siltation while removing the material has been approved.

All trails and fire lines should be seeded or mulched, cross-ditched, or waterbarred before the first winter after construction. Spacings and design of crossditches and waterbars should be adequate to remove water from the trail before it gains enough erosive power to cause rilling. The water should be discharged onto materials or structures which will dissipate its energy and disperse the flow to prevent erosion of the slope below the waterbar.

Buildings and Other Structures. Since a number of structures are necessary to support the mining operation, proper siting and designing can significantly lessen their impact.

The agency involved should require a site plan of all buildings proposed during the life of the mining operation. The planned structures should be examined relative to their visibility from public roads, color compatibility with surrounding landscape, and siting to avoid skylines and conflict with dominant landscape features. The lessee should flag or stake proposed building corners for a joint field examination with the involved agency prior to approval of the mining plan. The agency should furnish an engineer, landscape architect, and architect, if required, to evaluate the entire proposal as individual buildings relate to one another and to the surrounding landscape. Approval of the lease should include methods for removing the structures and returning the site to a natural or planned condition.

Building sites on steep terrain can result in mass wasting or excess site disturbance if they are incorrectly located or carelessly constructed. To reduce the potential for mass wasting and reduce the loss of site potential from structure, transportation facilities, etc., the following precautions should be considered:

1. Size and location of sites and construction of buildings should conform to local ordinances and regulations. Leases should contain stipulations requiring proper compliance.
2. Where practicable, topsoil should be stripped from the site and stockpiled for replacement after work has been completed and the area is ready for rehabilitation. Care should be taken to insure locating the stockpile where it will not contribute to or cause mass wasting or additional erosion.
3. Topsoil stockpiles should be seeded, mulched or covered to prevent soil erosion if they are to remain over a winter season.
4. Debris left in steep, ephemeral stream channels are often the source of debris slides during winter storms or spring runoff. Debris from construction activities should be removed from these channels promptly.
5. Construction methods which leave an over-steepened fill on a slope

A master transportation plan is required of the lessee as an integral part of the proposed mining operation plan. This railroad bed will be used to haul coal from the Westmoreland Mine to South Central Montana.

below a building site create a potential for sliding or slumping. Such conditions should be avoided or preventative measures taken to stabilize the slope.

Following removel of structures, heavily compacted areas may need to be scarified or ripped to a depth of 15 to 18 inches, or to hard bedrock, whichever is shallower prior to revegetation. Stockpiled topsoil should be evenly distributed over the area and the surface roughened on the contour prior to seeding. Erosion should be controlled until vegetation is reestablished.

Buildings and other structures should be designed to utilize the least amount of soil surface possible. This will lessen the impact of changing ground from its natural state.

Where possible, facilities should be located away from important and crucial wildlife habitats. Habitat for rare or endangered species should be identified by professional wildlife biologists and excluded from leases, or protected by special lease stipulations.

Construction of outlying facilities (i.e., roads, fences, and powerlines) in areas where wildlife will continue to use critical habitat should be timed seasonably to minimize adverse impacts.

Impacts are minimized if power and water sources and if sewage disposal are on site. If utilities must be routed to the mining operation they should be placed in a utility corridor so that all the disturbance is concentrated. Ideally, it should be combined with the design and location of the road and/or railroad so that total impacts and rehabilitation will be minimized.

Further steps can be taken to reduce the visual impact of utility structures, including fences. Poles and posts may be colored to blend with the surroundings and their placement should avoid skylines. Water tanks should avoid skylines and be painted to harmonize with surroundings. Powerlines located on or near heavily used flyways should be placed underground. Safety devices, to prevent electrocution of perching birds, should be installed on power poles and cross arms. Utility poles located near busy roads should be designed to prevent raptors from perching on them.

The impacts on historic resources of all on-site facility construction, mine operations and transporation facilities can best be mitigated by avoidance. Other measures can be taken to mitigate impacts to some degree, as described above in dealing with Exploration and Mine Development.

Upon abandonment, revegetation of road and other facility sites as discussed under overburden-waste piles-settling ponds will restore most wildlife habitat.

Fences. Fences should be kept to a minimum on big game migration routes. If fences are necessary they should be built incorporating features to allow passage and reduce hazards to such species as antelope, deer, elk, and moose. An exception would be where fences are necessary to keep the animals out of a particularly hazardous area. In this case, the fence should be designed to do the job adequately.

Upon abandonment, revegetation of road and other facility sites as discussed under overburden-waste piles-settling ponds can restore most wildlife habitat.

Mine-Mouth Coal-Fired Electricity Generating Plants

Control devices will, when functioning properly, reduce emission of particulates, greater than approximately two microns in size, to meet Federally approved air quality standards.

Technology to remove 85-90% of SO_2 emissions is presently available although capital costs and economics may be prohibitive for many operations.

Emission of water vapor from cooling towers and ponds can be partially mitigated by using dry cooling towers.

Consumption of water resources can be partially mitigated by using dry cooling towers which consume 1,500 acre feet of water per 1,000 megawatts per year versus 10,000 for wet cooling with ponds or 15,000 for wet cooling without ponds.

Thermal pollution of streams, rivers, and lakes can be partially mitigated by using dry cooling towers.

Impacts of the facilities themselves on various environmental components, people and human value resources can be mitigated as previously discussed.

Regulatory Procedures

Departmental regulations exist which govern BLM-USGS supervision and administration of mined areas relative to surface management operations and reclamation. These include:

- 43 CFR 23, Surface Exploration, Mining, and Reclamation (post January 18, 1969)
- 30 CFR 211

In addition, the GS is proposing revised regulations under 30 CFR 211 which govern their authority to administer and supervise coal mining operations.

43 CFR 23, Surface Exploration, Mining and Reclamation of Lands. These Departmental regulations require that, with respect to the exploration for, and the surface mining of minerals, adequate measures be taken to avoid, minimize, or correct damage to the environment – land, water, and air – and to avoid, minimize, or correct hazards to the public health and safety. The regulations prescribe procedures to that end and provide for the protection and conservation of nonmineral resources during operations for the discovery, development, surface mining, and onsite processing of minerals under permits, leases, or contracts issued pursuant to: The Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181-287); the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351-359); the Materials Act of July 31, 1947, as amended (30 U.S.C. 601-604); and title 23, United States Code, section 317, relating to appropriation for highway purposes of lands owned by the United States.

The present regulations will be expanded to include all leasable minerals including oil and gas, geothermal steam and extended to include minerals reserved to the United States underlying lands of which the surface is not owned by the United States. The primary purpose of the revision is to update regulations governing measures to be taken to avoid, minimize or correct damage to the surface value and to avoid, minimize or correct hazards to the public health and safety. It also expands the regulations to cover all types of permits, leases and contracts for minerals over which the Government has responsibility for both surface and sub-surface protection of the non-mineral resources and rehabilitation of areas disturbed as a result of the operations.

In addition to the above, those portions of the regulations in Part 23 spelling out the duties and responsibilities of the BLM as a surface managing agency will be re-codified in 43 CFR, Part 3040. And those portions of the regulations spelling out the responsibilities of GS will be contained in 30 CFR, Part 211, Coal Mining Operating Requirements.

Prior to formalization of the above 43 CFR 23 procedures in 1969, coal leases and prospecting permits contained the following 43 CFR 3031 wording relative to protection of the surface, natural resources, and improvements. The following wording failed to provide needed full consideration of comprehensive, multiple resource, land use planning for the site or region impacted by the mining or exploratory operation. Many valid leases still exist which are subject to the old section 5 clause. "The lessee agrees to take such reasonable steps as may be needed to prevent operations, including operation of operating plants on the leased premises, from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth on the leased lands or on Federal or non-Federal lands in the vicinity; (2) polluting air and water; (3) damaging crops, including forage, timber, or improvements of a surface owner; (4) damaging improvements whether owned by the United States or by its permittees or lessees; or (5) destroying, damaging, or removing fossils, historic or prehistoric ruins, or artifacts; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required and to the extent deemed necessary by the lessor to fill any sump holes, ditches, and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land and access roads to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon, whether or not owned by the United States."

Fences should be kept to a minimum on big game migration routes. If fences are necessary they should be built incorporating features to allow passage and reduce hazards to such species as antelope, deer, elk, and moose.

The existing regulations in 30 CFR 211 were promulgated by the Secretary of the Interior to govern coal mining operations on Federal and Indian lands. They will be interpreted and administered in accordance with the policies of the National Environmental Policy Act of 1969. All operations must be conducted in accordance with the requirements of the Federal Water Pollution Control Act and the Clean Air Act. The proposed revision of the regulations will update the existing regulations by deleting or amending obsolete provisions and by adding new requirements which more fully reflect present administrative procedures and modern mining practices. The amendments include provisions specifying the obligations of operators for the protection of the

environment during operations and for the reclamation of lands affected by their operations. The proper implementation and enforcement of these regulations will mitigate the environmental damage from coal mining on Federal and Indian lands.

The Mining Supervisor of the Geological Survey has been delegated the authority for the regulatory supervision of mining operations under Federal and Indian coal leases and prospecting permits. He is empowered to regulate operations and to perform other duties prescribed in these regulations, either personally or through subordinates acting under his direction. The Supervisor is required under the existing regulations to make frequent inspections to insure that the regulations, the terms and condition of the lease or permit, and the provisions of approved exploration or mining plans are being complied with and to determine the adequacy of water management and pollution control measures. The Mining Supervisor issues orders to operators for noncompliance with these regulations, other applicable Departmental regulations, the terms and conditions of the lease, and the requirements of the approved mining plan. For continued noncompliance, or if the operator's failure to comply threatens immediate, serious, or irreparable damage to the environment, operations can be immediately suspended by the Mining Supervisor.

The proposed regulations govern operations for the discovery, testing, development, mining, preparation, and handling of coal, and for the reclamation of lands disturbed by such operations. These proposed regulations apply to all Federal and Indian land coal leases and permits regardless of surface ownership. As in 43 CFR 23 procedures, the operator is required to observe good practices following the highest standards in performing any operations on leased land and must use practices which avoid, minimize, or correct damage to environment – land, water, and air – and avoid, minimize, or correct hazards to public health and safety. These proposed regulations similarly require effective reclamation of lands disturbed by mining operations.

The proposed regulations require the operator to dispose of all solid wastes resulting from mining and preparation of coal in a manner that will not cause air and water pollution and will not spontaneously ignite. Waste piles shall be shaped to blend into the surrounding area, covered with topsoil and revegetated. This will be detailed in the mining plan.

The regulations of 30 CFR 211 require a pre-planning process that identifies measures to protect the environment. Section 211.10 requires that an exploration or mining plan be submitted for approval to the Area Mining Supervisor before conducting any operations. Other agencies involved and the public will be consulted, and their veiws and comments will be considered prior to approval of a plan. The plan shall show in detail the proposed exploration, testing, development, mining, and reclamation operations to be conducted. The development of this plan will require that each phase of the operation be preplanned to insure adequate reclamation and other measures to protect the environment.

As concurrently required under 43 CFR 23, the exploration and mining plan shall include a description of the environmental conditions and land use within and adjacent to the area and the projected use after completion of the operations. Measures to be taken to prevent or control fire, soil erosion, pollution of surface and ground water, pollution of air, damage to fish and wildlife or their habitat, or other natural resources and hazards to public health and safety will have to be evaluated and implemented. A specific reclamation schedule will have to be formulated and implemented with consideration being given to grading, soil preparation, and revegetation. The method of refuse and overburden disposal and water impoundment, treatment, and control will have to be designed prior to commencement of operations.

The regulations may require that specific performance standards for the reclamation of surface coal mines on Federal and Indian land shall be followed. These standards will be included in the mining plan and enforced by the Mining Supervisor.

The operator will be required to reclaim the mined area in accordance with State law or Federal Land Managing Agency requirements, whichever is more stringent. The reclamation requirements will require that adjacent or surrounding lands will not be affected by continuing air or water pollution from the mined area. If the operator fails to take appropriate action, the performance bond may be used by the Federal Government to perform the necessary reclamation. The Leasing Agency (BLM) is responsible for setting the bonding requirements for each lease. The bonding requirements are established in cooperation with GS and the Land Managing Agency.

The following is a list of performing standards:

1. Mined areas, including highwall, shall be returned, as soon as feasible, to their original contour or to a similarly appropriate contour considering the surrounding topography and possible future uses of the areas.
2. There shall be no deposition of spoil material on the undisturbed or natural surface within or adjacent to the mined area, except as necessary to the original excavation of earth in a new mining operation.
3. Reclamation shall be conducted concurrently with the mining operation.
4. Throughout the mined area, soil conditions shall be stabilized, and water management shall be conducted so that landslides are prevented; erosion is minimized; and water pollution by siltation or by acid, highly mineralized, or toxic material drainage is minimized.
5. *Fire prevention.* Accumulations of slack coal or combustible waste shall be stored in a location and manner so as not to be a fire hazard. If a coal seam exposed by surface mining becomes ignited during the term of a lease, the operator will immediately extinguish the fire.
6. *Coal Face to Be Covered in Strip Pits.* Upon completion or indefinite suspension of mining operations in all or any part of a strip pit, the face of the coal shall be covered with non-combustible material that will effectively prevent the coal bed from becoming ignited.

7. *Underground Workings from Any Strip Pit.* The driving of any underground openings by auger or other methods from any strip pit shall not be undertaken without prior written approval of the Mining Supervisor.

The regulations, 30 CFR 211, require that the operator maintain surface openings in a safe manner during operations; and upon abandonment of the mine, all openings must be permanently sealed. These procedures shall be made a part of the mining plan.

Chapter Five

Adverse Environmental Impacts That Cannot Be Completely Mitigated

Adverse Environmental Impacts That Cannot Be Completely Mitigated

The major environmental issue is essentially whether or not an orderly system of lease activity and potential subsequent development is environmentally superior to unregulated leasing.

This section discusses impacts that will remain despite application of mitigating measures. Included are the unavoidable impacts not subject to mitigation and the remaining adverse impacts that can be only partially reduced.

Unmitigable impacts are presented in two parts. The first part considers impacts on land uses, population patterns and considerations, and human-value resources. The second part considers impacts that exploration, development, and production actions have upon the natural environmental components. These anticipated residual impacts are those that may accrue from orderly systematized leasing-exploration-development versus random leasing with associated impacts.

LAND USES AND SOCIOECONOMIC VALUES

Land Uses

Agricultural. Rehabilitation success varies with areas and climate. It may not be possible to immediately restore an area so it will grow the same type of crop. The soil productivity may also be lowered on some sites when profiles are altered. Larger tracts mined may contribute to greater economical efficiency in reclamation.

Timber Production. Residual impacts during the exploration phase on timber production are generally minor and limited primarily to a temporary setback in timber production on relatively small areas. There is usually time to harvest timber from coal fields before development. In limited cases of inadvertent toxic spoil, saline water contamination, soil compaction, or loss of redistributed soil by erosion, total native reforestation may be less than satisfactory. This may require artificial revegetation. Differences in forest types and the kind of rehabilitation practices used will also determine the extent of unmitigated damage.

Mining. Surface slumping or subsidence can occur after coal has been extracted despite mitigation measures. The resulting instability can adversely affect the recovery of other minerals such as gravels.

Coal mining results in loss of the resource other than that produced and used. Mining losses within a single coal bed can vary from as little as 10% in surface mining to as much as 80% in underground mining of thick coal beds. Greater recovery is a monumental challenge facing the industry.

Drilling that cannot be completely controlled and occurs when unscrupulous operators drill illegally for coal information through subversion of the 1872 Mining Law. In order to drill for coal on Federal lands, one must have a valid coal prospecting permit or lease. The Federal Government has not authorized any prospecting permits since January 1971. Before a company or individual bids on a competitive lease, he wants to know as much as possible about the coal, overburden, soil, and other factors. Since the Federal government has not recently authorized private drilling for coal data, some drillers have alleged that they were drilling for locatable hardrock minerals such as gold, lead, zinc, copper, uranium, etc. The Federal government can regulate drilling for leaseable minerals, but cannot under existing laws control drilling for locatable minerals.

Urban. Coal mining requires serious land-use planning and coordination when operations are conducted in proximity to residential, commercial, or industrial areas. Some degradation is inevitable. However, this may be politically acceptable in established mining communities.

Recreation. Roads and structures associated with coal development change the character of the natural landscape. While increased access provides a beneficial impact to many recreational users, especially those using ORVs for primary or secondary recreation purposes, the general impacts are temporarily adverse.

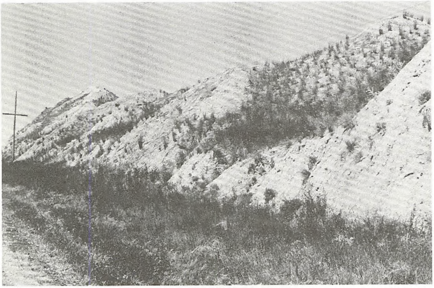
If coal were to be mined within areas technically of wilderness quality there would be a wildland impact not

With proper climate some natural rehabilitation takes place, but this abandoned Dakota Star mine and town shows no plan to return the land to any productive use.

capable of being totally mitigated until the operation is complete and the locale rehabilitated.

Recreation based on both consumptive and non-consumptive use of wildlife resources may be adversely affected to varying degrees dependent upon the extent of development and degree of reclamation success within a given area or region. Much of this impact cannot be immediately mitigated. Increases in humans, living, working and recreating on the land, cannot help but to increase competition between man and wildlife for food, water, cover and living space at many levels. While some species may benefit from these increased human activities, and recreation opportunities based on these species will be expanded, many of them will be adversely affected and recreation opportunities will be reduced.

New industry is usually accompanied by more people, more money, more free time and greater demand for wildlife based recreation. This also increases the competition between humans and human groups for various types of wildlife based recreation. The end result in most instances may be a temporary reduction in the array of wildlife based recreation opportunities available to the individual. However, with completion of land and vegetal rehabilitation, recreation values are in many cases actually enhanced.



Natural rehabilitation on 30-year-old spoil piles at Old Northern Pacific Operation, Colstrip, Montana.

Socioeconomic Values

Social. An influx of outsiders, attracted by coal mining and energy plant operation will significantly impact on sparsely populated areas and small communities. This influence may be both for the good and for the bad. Conservative social values of traditional populations will have to change somewhat to accommodate more liberal values brought by newcomers. Impact is dependent on the ability of local populations to accept social change. Immigration of a modest number of people into a small community could result in their being welcomed and rapidly assimilated into the existing social fabric. On the other hand, the influx of large numbers of people would probably create some adverse social impacts. So far as radical changes affect the social fabric, rates of delinquency, crime, personality disturbance, alcoholism, alienation, and rootlessness may be increased.

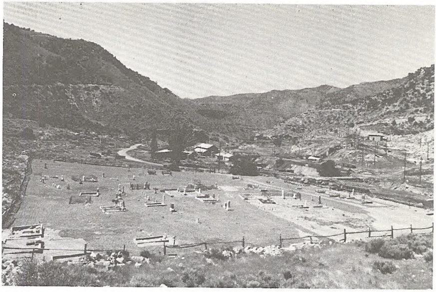
Political. Immigrant populations, dependent on and oriented toward coal mining and energy conversion and the influence of powerful business corporations engaged in the same and related industries cannot help but threaten established political patterns. Insofar as they are able to dominate the existing political establishment through numbers and corporate influence, they will affect political life of a community, county, or state.

Economic. The impact on the ranching, agricultural, and recreational aspects of local economies cannot be entirely mitigated. Lands used for mining and plant purposes, as well as attendant transportation routes, might be removed from these aspects of the local economy. People whose liveli-

hood derives from these uses will suffer some degree of economic dislocation and loss or gain. The unmitigated economic impact will arise to the extent that local populations do not derive economic benefits from the advent and expansion of coal mining and energy conversion development and production. This is not necessarily valid, however, since the economy will probably not only flourish but boom.

Ethnic. Native Indian groups, and to some extent all other ethnic minority enclaves, will be affected by the advent of coal mining and energy conversion in or adjacent to their communities. An influx of newcomers might result in some degree of ethnic dilution due to intermarriage. Indians, Eskimos, Hispanic-Americans, and communities of earlier settled "American ethnics" in the plains, deserts, and mountains will all be affected to some degree be it to their benefit or detriment.

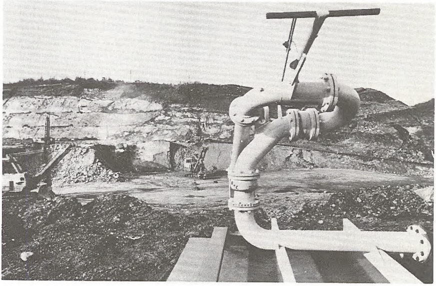
Cultural and Religious. Economic, social, political, and ethnic factors of status and power in a community interact with and heavily influence cultural and religious lifestyles. To the degree that population patterns change, without positive progress to preserve existing cultural and religious patterns, the impacts on these cultures will remain unchanged. Indian, Eskimo, Hispanic, other ethnic and nationality groups, and communities whose lifestyles are rooted in traditional ranching and agriculture and their related culture values will be deeply affected if large numbers of immigrants enter these areas as the result of coal mining and energy activities. Land uses will change. The social fabric may be altered by the influx of newcomers, and the cultural framework for what it's worth will never be the same again. What have been dominant cultures will have to change to some degree to accommodate new people and new conditions. The level of change and what elements of it remain will depend on the numbers and power of the newcomers, their acceptance of and sympathy for existing cultures, and programs to buttress and encourage the viable continuance of these cultures. Cultural and religious changes are always affected by change. To some degree, culture groups will suffer severe personal and group cultural loss. Indian groups could be especially affected permanently. Loss of cultural diversity of language, arts, lifestyle, and folklore might be permanent. Immigration of numerous newcomers and altered economic, social and political power structures could easily overwhelm existing Indian and other cultural groups. Loss of cultural identity for individuals and groups is a significant factor in producing alienation from their world.



Mining cemetery at Castlegate, Utah.

Health and Safety. Accidental deaths and injuries may take place despite safety measures. Where industry personnel are concerned, the magnitude of the problem from year to year is about directly proportional to the number of workers involved.

If proper precautions are taken (patrolling roads, signing, shutting down operations when climatic conditions warrant, etc.), to protect the health and safety of the general public, accidental deaths, injuries and health problems can be kept to a bare mini-



There will be substantial unavoidable impacts on the visual environment during the operational period of all phases of coal operations.

mum. The hazards, however, cannot be completely mitigated.

Esthetics. There will be unavoidable short term impacts on the visual environment during the operational phases of strip mine coal operations. Vegetation patterns are interrupted. Structures are placed on the landscape for varying time periods in the exploration, development, and production phases. Movement of soil will occur. Each of these actions interrupts the natural character of the landscape, and none can be immediately mitigated. Semi-arid areas with less than 10 inches annual precipitation and tundra will have the slowest recovery rate unless irrigation is applied.

Historic. Unregulated coal exploration could destroy historic ruins, trails, and earthworks. Any carelessly conducted activity, be it coal development or production that disturbs the historic surface, or subsurface in rare cases, threatens loss of tangible historical resources. This risk is always present regardless of conscientious preplanning. Rugged hills and valley bottoms where historic Indian actions occurred, and which largely determined the course of history, would be altered.

Relocated historic structures could suffer loss. Likewise, obtrusive coal operation roads, structures, and other developments adjacent to historic places will temporarily lessen their historical value to the degree that the scene and setting have been changed.

Geologic. Geological stratigraphic relationships, geomorphic features of human interest value, paleontological specimens, limestone caverns and caves, badlands areas with various colored strata exposed, hydrologic features of human interest such as waterfalls, and all manner of scenic areas will suffer adverse environmental impacts that cannot be completely mitigated if the ground surface or the level at which they are found is disturbed.

Much of the landscape can be rehabilitated and the adverse impacts reduced, but no amount of manmade rehabilitation can restore a disturbed site to its original form. Original natural features, once lost, are gone.

Archeologic. Impacts on the archeologic environment that cannot be mitigated are those associated with surface disturbance. The threat of inadvertent utilization of terrain hosting undetected archeologic, paleontologic and historic values will always remain despite reconnaissance and clearance even by skilled professionals.

Impacts on the archeological environment which cannot be mitigated are those associated with surface distrubance. A strip mining operation could destroy tepee rings similar to these.

ENVIRONMENTAL COMPONENTS

This section describes the impacts that coal exploration, development, and production have upon the five components of the environment that cannot be completely mitigated. They are: (1) Non-living components; (2) Living components; (3) Ecological interrelationships; (4) Aesthetics; and (5) Human interest values.

Non-Living Components

Erosion processes are accelerated any time the protective cover is removed or the soil is disturbed. Mitigating measures after major disturbances reduce erosion, but very rarely eliminate it. Productivity of the natural vegetation will be reduced if the soil is disturbed or compacted. Some fill or cut bank failures occur when roads or trails are constructed on steep terrain. Of all exploration activities, road construction will cause the maximum permanent damage to the soil.

Some sediment may be produced by all except airborne exploration activities. The sediment may adversely affect water quality. The amount of suspended sediment produced after mitigation from any one action on a specific area will vary with conditions.

Unfilled pits may collect poor quality water.

Surface mining alters topography and hydrology despite mitigation measures. There will be spoil pile mounds in areas that were once nearly level. The spoil cannot entirely be replaced in its original location in steeper topography. Actions which change the topography of an area also change the surface drainage patterns.

Stream crossings will inevitably produce suspended sediments. The act of constructing adequate stream-crossing structures and fords will increase suspended sediment during the construction phase. Unexpected, or unusual, peak flows may cause stream-crossing structures to fail. These climatic events may also cause coal pits to overflow and the contents to enter stream channels. Failure of earthworks that contain settling ponds during heavy rains may allow sediment or toxic material to reach streams, lakes, and marshes.

Changes in natural surface drainage systems can cause unmitigatable impacts on the drainage system below the mine operation. For example, settling out the sediment normally contributed by the upstream portion of the stream, or adding sediment-free mine water to the stream can cause increased channel erosion below the mine operation.

Geophysical data may be misinterpreted and aquifers may be overlooked and subsequently disrupted by stripping or mine development.

There is a possibility of physical damage to an aquifer due to blasting. Should this actually occur, it would represent an adverse effect which would be virtually impossible to rectify by any measures.

In some underground mine operations drainage of good-quality water for aquifers in the vicinity of the mine is unavoidable. This can become a severe problem in arid or semi-arid areas where previous water users have no other available water source. The area affected by mine dewatering would be dependent on the depth of the mine, the permeability of the aquifers affected, and the recharge characteristics of the aquifers. Contamination of usable aquifers due to changed head relationships in aquifers resulting from mine dewatering can also cause unmitigated impacts.

The original natural soil arrangement cannot be reconstructed after it is moved, compacted, or altered during construction of coal mining or powerplant facilities. The losses in soil productivity and vegetation cover may be minimal where the precipitation exceeds 10 inches and severe in areas receiving less than 10 inches. In these semi-arid areas, especially in the southwest, vegetation is sacrificed where construction of buildings, roads, and railroads, and spoil areas occur. The sites of utility poles or towers would also suffer unmitigated impacts on vegetation.

The major underground mine characteristic that cannot be completely avoided is subsidence or caving. Degree of subsidence depends upon mining methods, thickness of seams, and depth from the ground surface. Old or even new workings may collapse, changing the character of the surface. It may affect both surface and ground water, crack foundations, open cracks or pits on the surface, and cause roads or structures to sink. This is a major concern under towns or developed areas. It is not always possible to predict the rate of subsidence, when it will occur or how large an area will be affected.

The waste material brought to the surface from underground mines may cover existing vegetation or fill a valley or drainage. It may cause acid or alkaline leaching to enter drainages. It may set up unstable soil conditions on steep slopes or on waste piles. Dust problems may arise before surface cover is reestablished. These problems cannot always be completely mitigated.

Frail ecosystems, where productivity is low and the natural balance delicate, will be the most severely impacted and slowest to recover.

Potential extractive techniques causing subsidence would have similar unmitigated impacts.

Underground coal fires periodically occur despite safety measures. Fires waste the coal resource and damage surface values by emission of smoke and gases and by inducing subsidence.

Even with good cooperation by the coal industry, application of all feasible mitigative measures and careful observance of operational rules and regulations, there will continue to be some impacts upon air quality.

Strict enforcement of air-quality standards cannot entirely eliminate atmospheric pollution by coal operations. Air quality will inevitably be degraded, at least temporarily and locally, by engine emissions and dust arising from road, drilling site, and pit construction as well as from movement of surface vehicles. Accidental coal fires will occasionally add toxic vapors and particles to the load of noxious materials already in the atmosphere.

During coal mining, subsurface material with higher concentrations of certain soluble elements than are found in surface materials is transported to the surface. Introduction of these elements into the surface environment, water, air, plants, animals, and man, changes interrelationships in varying degrees from what they were before.

The impact of not removing carbon dioxide, ozone, and hydrocarbons may be significant only locally and temporarily; however, there may be some cumulative effects on the upper atmosphere (and hence on the earth's general climate) which are not yet fully understood, as discussed in W.J. Maunder's 1969 work, *Pollution*.

No immediate techniques exist to individually control emissions of hazardous trace elements, beryllium, mercury, cadmium, chromium, nickel, selenium, arsenic and manganese. The actual effects of these elements are presently being studied.

With the best of mitigation, 1,500 acre feet of water per 1,000 megawatts per year will continue to impact air and climate as vapor.

Reduction of water quantity for use by other resources amounting to at least 1,500 acre feet per megawatt per year cannot be avoided.

Aqueducts used to transport water to on-site power plants in water-short areas would interfere with natural drainage systems and either cause additional erosion or deposition of sediment in the natural stream channels. Diversion of good-quality water from a stream that has poor or marginal quality in its lower reaches could cause further deterioration in the stream's quality.

Water pollution from airborne oxides of sulfur and nitrogen cannot be totally avoided.

Living Components

Proper administration of Federal coal-drilling permits by the Federal land-managing agency and the Geological Survey will generally leave few unmitigated environmental impacts. Revegetation of areas disturbed by roads and drill sites requires varying treatments and lengths of time depending on the climate, soil, and terrain. Widespread ORV use in exploration areas will result in damage to vegetation. This effect is usually temporary.

Exploration drill sites, pits, and trenches eliminate vegetation, and in the semi-arid southwest, where precipitation is 10 inches or less, revegetation is very slow. The same is true in areas underlain at very shallow depths by materials not capable of supporting plant growth.

The immediate impacts of relatively small terrestrial habitat losses cannot be mitigated. Rehabilitation of sites damaged by ORV use and earthmoving activities will mitigate the long-term effects. If roads and trails are not closed to public use during and after rehabilitation, habitat damage may be relatively permanent.

Despite mitigative measures during exploration, erosion and sedimentation of surface waters will occur from roads, drilling sites, trails, ORV travel, and test excavations. Some damage to aquatic resources and fish habitat will occur, the magnitude depending upon variables such as soil types, terrain, climatic conditions, and degree of development.

Some aquatic vegetation will be destroyed or buried by road or trail construction at streams, marsh or lake crossings. The loss in productivity would depend on the magnitude of destruction and would be long-term in nature, unless a similar amount of vegetation could be replaced elsewhere in the ecosystem.

The destruction of aquatic vegetation caused by a massive earth slide down a stream channel cannot be reasonably mitigated in most cases after the slide occurs.

Sedimentation of aquatic ecosystems may be increased above natural levels despite all mitigative efforts to prevent it. Unavoidable sediment deposits in stream and lake habitats will result primarily from roads and trails.

While most impacts on wildlife through the exploration phase can be reduced by implementation of mitigating measures, some mortality, displacement, and temporary habitat loss may be unavoidable.

Cross-country ORV travel, exploratory road, trail, and drill site construction, movement of exploration equipment, and test-trenching operations may cause dislocation of wildlife. These losses will be relatively insignificant depending upon the extent and duration of operations, and primarily involve bird nests, young birds, rabbits, burrowing rodents, reptiles, and invertebrates.

The impact on wildlife from mine facility development cannot be mitigated in the immediate area of the facilities during the life of the mine. During construction, the wildlife and wildlife habitat will be displaced or destroyed. Small sedentary animals are more prone to destruction, while larger animals such as some big-game species and predators will leave the area. Mitigation through habitat rehabilitation cannot be accomplished until the facilities are removed, usually after 30 to 40 years. Effects on some species may be permanent, depending upon the type of rehabilitation employed and the land uses after mining.

The displacement of animals that are sensitive to man's activities cannot be mitigated until these activities cease.

Hazards to wildlife from roads, fences, trains, powerlines, etc., cannot be completely mitigated. Construction of new roads, even with high engineering standards, has a residual impact on wildlife never fully erased. Some animals may be unavoidably killed despite efforts to reduce loss.

The hazards to aquatic life from sediment pollution cannot be completely mitigated. After the initial facility construction period, erosion control measures and revegetation of unused areas will decrease the accelerated erosion. Sediment loads from the original construction will already be moving downstream and sediment from road drainages, poorly revegetated areas and new construction activities will continue to cause some sediment pollution.

The long-term ecological effects of sedimentation of streams, ponds, and lakes are often of greater consequence to aquatic species than are immediate short-term effects of direct mortalities.

Natural surface waters such as springs, ponds, lakes, marshes, and streams along with their associated plant communities are vital to the survival of many aquatic and terrestrial wild animals. Where subsidence or surface mining causes drastic physical changes in or losses of such water, a variety of associated wildlife species will be subject to adverse impacts, especially in arid areas. Many of these impacts will not be subject to mitigation.

Excessive water demands could lower water tables and drain small lakes or ponds or dry up small streams if the water comes from local sources. In arid areas all water sources may be critical to wildlife. Loss of these sources would destroy aquatic species and many terrestrial species.

Any disruption of aquifers caused by the removal of the coal, itself sometimes an aquifer, causes an unmitigated impact.

Accidents during production may contribute additional sediment to streams and lakes. The long-term effects of excessive sedimentation are often more serious to aquatic plants in

shallow water habitats than short-term effects from a single pollution kill.

Trout, salmon, and many other fish require clean spawning gravels for reproduction. In certain waters of most coal provinces, existing conditions are already marginal for some of the cold-water game-fish and anadromous species. Heavy sedimentation of these waters can result in their permanent elimination.

Stream crossings or other activity that introduce suspended sediment into bodies of water which contain aquatic organisms is going to cause some damage to these populations. Leakage of toxic substances into these waters can occur through failure of containment structures. Damage to aquatic populations may occur through the discharge of hot water into a body of water even though the discharge may otherwise be of good chemical and physical quality.

Animal populations displaced or destroyed can usually be replaced from populations in the surrounding ranges provided the habitat is eventually restored. If a threatened species is involved, however, the loss may be a permanent unmitigable impact.

In some instances, it may be impossible to completely mitigate secondary impacts upon contiguous resident populations and habitats. Animals displaced from home ranges may be forced to use adjacent areas already stocked to carrying capacity. The resulting degradation of the adjacent habitats, the forced interactions with the resident animals and, potentially greater losses to the original populations involved are seldom subject to more than token mitigation.

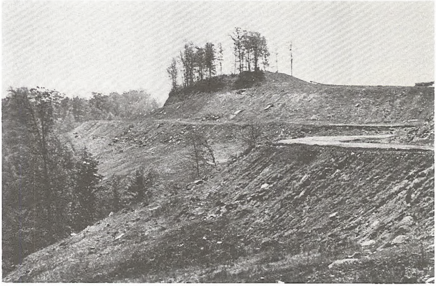
Changes in access patterns in a region will have definite impacts on man's utilization of game and fish species. Game and game-fish will be subjected to increased exploitation pressures in general. Local and easily accessible populations may be excessively exploited. Large areas around mining-industrial complexes may be restricted to hunting and fishing. These considerations can be mitigated only to limited degrees by more intensive management of wildlife and wildlife habitat. It can become necessary to reduce big game, predator or "nuisance" animal populations displaced by human activities to prevent overuse of remaining habitats and conflicts with other human uses.

Surface mining leaves a change in topography and hydrology despite mitigation measures.

Ecological Interrelationships

Any industrial action that alters the abiotic environment or biotic community can influence ecological relationships to some degree; mitigative measures cannot be entirely effective. Despite all feasible precautions, some coal operations will upset the natural balance of ecosystems, at least temporarily. Actions or accidents that destroy vegetation, disturb soil, degrade water quality, and pollute the air will cause some disruption of ecological interrelationships. In these instances, the nutrient cycle and hydrologic cycle may be interrupted until the affected area is revegetated and soil is stabilized or until the source of disruption is removed.

Fragile ecosystems, where productivity is low and the natural balance delicate, will be most severely impacted and slowest to recover, particularly where the ecological equilibrium has been impaired by other human activity prior to coal operations.



Actions which change the topography of an area also change surface drainage patterns.

Whenever soil is disturbed, eroded, or removed, soil organisms will have their life cycles interrupted and populations will decline for an unknown time. There will be shifts in populations among species as food and energy sources are changed.

Whenever the natural interactions of parent material, vegetation, topography, and climate are disrupted by any action, the soils will be affected. Mitigating measures cannot immediately and completely restore soils to their former state. Soils may be stockpiled, moved, and redistributed, but to some degree, the impacts will remain until the interactions again have time to reach equilibrium. The time required for equilibrium ranges from decades to a few hundred years in areas of high rainfall to many hundreds of years in arid climates, more particularly those with less than 10 inches of precipitation annually.

Some properties of topsoils are not restored until equilibrium with the environment is reached. Nutrient recycling, profile development, and organic matter cycling are examples of items not completely mitigable.

Roads, railroads, building sites, and waste disposal sites are areas on which impacts on soils continue for the life of the facility. Rehabilitation measures are only the first step which must be followed by a chain of natural processes that must continue for a long time before former equilibriums are restored.

Post-mining rehabilitation if aimed at establishing an entirely different ecosystem in terms of vegetation, topography, and land use will drastically influence wildlife. Some lands could be rehabilitated for intensive human use; others could be rehabilitated especially for wildlife or for intensive agriculture. The types of wildlife which would be able to survive in each situation would vary greatly. Rehabilitation not geared to the needs of the endemic wildlife species, or drastic changes in land uses after rehabilitation, can preclude reestablishment of many members of the original fauna.

Damage to biota directly or through reduction of its resistance to disease by concentration of emitted gases and particulates, as during periods of little air movement, cannot always be precluded.

Aesthetics

Roads constructed in steep terrain invariably leave portions of the road prism visually denuded of vegetation unless in dense timber. Areas denuded by roads or ORV travel in the most arid areas will remain bare unless revegetation is initiated.

New industry is usually accompanied by more people, and greater demand for uncluttered outdoor recreational space. In rural areas, this sudden increase in people living and recreating on the land, will degrade open space, wildland aesthetics and displace wildlife and reduce habitat. Demands for homesites, utilities, water, roads, outdoor recreation facilities, etc., will diminish prior wildland resources and bring about a myriad of changes within undeveloped rural settings. Considering the whole coal leasing program, this area of concern is among those with the highest potential for unavoidable impacts.

While road and utility systems can be designed to blend into the landscape, the previously undeveloped character of an area will generally suffer. A mine mouth operation usually concentrates land uses at one or more select sites for a significantly long period of time. A strip mine operation results in a temporary alteration of scenic values. In the latter case, time and diligent reclamation may not only heal but actually enhance scenic values.

In summary, excessive human use of a onetime rural or wildland area invariably results in degradation of the very qualities that we most cherish and seek.

Human Interest Values

A major risk always inherent in any form of mineral development and more especially while strip mining is the accidental destruction of uninventoried historical or natural features that intrigue the intellect and excite curiosity. These may include examples of unusual geology, sites of ecological significance, archaeological values, mineral springs, and even old battlefields.

The BLM resource inventory and planning system is designed to identify these values. If their public worth is significant, they will be protected. The great danger lies in the fact that many natural features and archaeological sites are not easily detected and thus risk damage. An operation can always be stopped if values are identified, however at that point reclamation or protective measures may be too late.

Chapter Six

Relationship of Federal Coal Leasing to Long-Term Productivity and Management of the Land

Relationship of Federal Coal Leasing to Long-Term Productivity and Management of the Land

Coal will probably be mined from the Federal lands where mineral rights have already been leased regardless of whether or not the proposed EMARS is adopted. An orderly leasing system provides for the highest level of development consistent with comprehensive land use planning.

Coal is mined because it provides a needed source of energy to enhance the quality of our lives. When burned in stoves and furnaces, it releases energy, to heat homes and factories. Energy is converted to steam and electricity for domestic and industrial heat and power. Coal can be chemically converted to a myriad of useful products.

These needs must be weighed against onsite values and the environmental impacts of the coal-mining process. Similarly, the value of the land before coal was mined must be compared to the values of the land after mining. Sometimes, postmining land values exceed premining values. Usually, they do not. Any losses of value to the mined land must be compared to the enhancement of value elsewhere that resulted from the use of coal.

VALUES OF COAL AND COAL MINING

Economic

In 1973, total coal production in the United States amounted to 591 million tons while production under Federal leases mounted to 12.9 million tons or 2.2 percent of the total. The mine-mouth sale price received by the Federal leases in 1972 was $53.4 million. Income to the Federal Government in 1972 from coal leasing was $2.3 million.

If we assume a case where 85 percent of Federal coal produced in 1985 would be extracted by surface mining methods, about 37 surface mines each producing 5 million tons per year, and 17 underground mines, each producing 2 million tons per year, would be required to meet the projected annual 1985 production of 217 million tons.

By 1985 at an estimated 3% growth rate and at a 15% rate of return of capital an average value in the United States for a ton of coal produced from underground operations would be $9.60 and for surface operations $6.79 (NPC, Coal Availability, 1973). Assuming an average value therefore of $8.20 per ton of coal and a 1985 projected production of 217.5 million tons (Dept. Interior Lease Analysis, 1974), the gross value of federal coal in 1985 would be $1,780 million.

Part 211 of Title 30 of the Code of Federal Regulations is revised to read as follows:

Recent Departmental decisions support a royalty rate of not less than 5 percent for both underground and surface mine operations, and would permit higher royalty rates to be set on the basis of local current rates for similar mining situations. Using the above production and average tonnage value assumptions, royalties would result in a royalty revenue of about 90 million dollars, at the minimum rate of 5 percent or over 175 million dollars if the royalty rate averaged 10 percent. Of the royalty revenue generated, the States in which Federal coal is to be mined would receive 37.5 percent, or about 90 million dollars at the minimum of 5 percent and over 175 million dollars if the average royalty figure were 10 percent. This would be a small part of the total revenue generated for public use. Corporation taxes, employees income taxes, sales taxes, state taxes, local property taxes, plus the multiplying effect generated by a basic industry would generate substantial public revenue. This must be offset against additional public costs, particularly at the municipal level including school, hospital, sewage, etc., which would vary according to amount of labor per ton of coal production, and the nature of mining operations, strip or underground, and future improvements in productivity.

A surface mine producing 5 million tons of coal per year requires 200 employees (BuMines Inf. Circ. 8535). If each surface mine reaches 5 million tons of annual production in the assumed case, they would require 7,400 man years of effort. Using 30 year life and 5 million tons annual production by 1985, the 37 surface mines would require an original capital investment of $1,624 million and a total capital investment over the life of the mine of $5,200 million. The 17 underground mines would require $335 million original capital investment reaching $906 million over the

total life of the mine. These capital costs are in constant 1970 dollars (NPC, 1973 Coal Availability). Furthermore, using industry averages of 229 man days underground per year, 13.8 tons of underground production per man day (1970), the 17 underground mine operations would need a labor force of 10,700 men in 1985. The total labor requirements for projected 1985 federal production would be 14,400 man years and require an original capital investment of approximately $1,960 million dollars.

Enclosed in Tables 6-1 through 6-6 are listed socio-economic data for each of the six major western states with federal coal resources. Historical and projected population, employment, personal income, and earnings by industry are considered. Federal coal development will affect these parameters with projected capital investments of nearly $2 billion and an annual effort of nearly 15,000 man years. Personal income for coal mining will exceed that projected by the OBERS projections (1972).

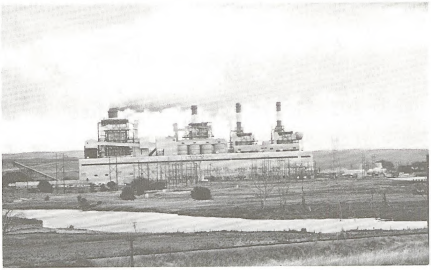
The projected increase in Federal coal production can in part be attributed to two valuable characteristics of major Federal coal deposits. Most strippable Federal coal can be classed as low in sulfur content. These factors make Federal coal preferred for power generation, gasification, and liquefaction. Federal coal in Wyoming and Montana, for example, is competititve with locally produced private coal in the Midwest for use in population centers around Chicago and St. Louis.

Plans are being formulated to build new gasification and liquefaction plants, using Federal coal primarily, to produce gaseous and liquid fuels.

These products can be substituted for natural gas and oil used in some powerplants.

Powerplants without coal-burning equipment can be converted to use coal, and new powerplants can be designed to burn coal as well as oil or gas.

To the extent that coal is substituted for oil and gas, imports of those products from other countries can be reduced, with subsequent improvement in the United States' balance of payments.



Even in compliance with air pollution control standards, it is inevitable that small quantities of pollutants will go into the air when coal is burned to generate electricity.

The abundance of and accessibility of Federal coal makes it an important fuel reserve for national security. The fact that much Federal coal can be mined by surface methods, which can be operational more quickly and with smaller investments and less personnel than underground mining, enhances its value for defense purposes.

The steel industry of Utah and California uses coking coal of high unit value mined in the Uinta region of Utah and Colorado. The role of coking coal is important in the western States' economies, even though the reserves are small in comparison with other supplies that can be used for power generation or direct conversion to other forms of energy. The deposits of privately owned coking coal are being rapidly depleted, so future supplies will be almost totally from Federal lands.

Social

Meaningful employment for workers in the coal mines, along with wages paid, has been a stabilizing social, cultural, and political factor.

Emission of less than two microns in size, which impair visibility and cause breathing problems, can be reduced only slightly.

Table 6-1
Population, Employment, Personal Income, and Earnings by Industry, Historical and Projected, Selected Years, 1950-2000
State – Colorado

	1950	1962	1980	2000
Population, Midyear	1,325,000	1,899,000	2,582,000	3,473,000
Per Capita Income (1967s)	2,051	2,622	4,582	8,037
Per Capita Income Relative (US=1.00)	.99	1.02	.96	.97
Total Employment	492,075		981,100	1,348,600
Employment/Population Ratio	.37		.38	.39
In Thousands of 1967 Dollars				
Total Personal Income	2,718,000	4,979,000	11,832,000	27,914,000
Total Earnings	2,145,933	3,998,764	9,039,600	20,913,700
Agriculture, Forestry & Fisheries	278,116	214,082	251,600	315,100
Agriculture	276,881	212,129	250,900	314,100
Forestry & Fisheries	1,230	1,952	(S)	(S)
Mining	56,302	98,998	159,400	237,200
Metal	23,006	37,155	52,700	79,700
Coal	21,316	10,319	18,100	24,600
Crude Petroleum & Natural Gas	8,860	46,950	82,400	121,600
Nonmetallic, Except Fuels	3,122	4,573	6,100	11,100
Contract Construction	163,995	297,523	581,200	1,319,100
Manufacturing	290,279	675,775	1,441,300	3,285,200
Food & Kindred Products	82,972	127,281	195,700	323,300
Textile Mill Products	314	631	(D)	(D)
Apparel & Other Fabric Products	5,854	6,400	(D)	(D)
Lumber Products & Furniture	14,109	19,441	43,800	82,300
Paper & Allied Products	3,093	6,528	15,000	35,200
Printing & Publishing	28,277	53,581	111,400	247,800
Chemicals & Allied Products	9,222	13,686	28,800	58,600
Petroleum Refining	2,332	8,435	12,100	21,900
Primary Metals	42,227	64,744	91,400	134,600
Fabricated Metals & Ordnance	19,064	174,502	267,600	711,800
Machinery, Excluding Electrical		42,741	210,300	512,200
Electrical Machinery & Supplies		25,673	97,100	286,600
Total Machinery (1950 Only)	22,949			
Motor Vehicles & Equipment	2,259	4,417	18,800	43,400
Trans. Equip., Excl. Mtr. Vehs.	1,798	25,365	41,300	114,200
Other Manufacturing	55,809	102,350	293,200	688,300
Trans., Comm. & Public Utilities	210,974	329,392	644,400	1,321,700
Wholesale & Retail Trade	460,472	766,886	1,646,500	3,826,400
Finance, Insurance & Real Estate	93,392	220,917	503,200	1,173,900
Services	256,483	590,054	1,548,900	4,110,100
Government	335,918	805,130	2,262,600	5,324,700
Civilian Government	243,745	617,140	1,827,800	4,591,900
Armed Forces	92.174	177.991	434,700	732,700

Population, April 1, 1970: 2,207,259
OBERS Projections (1972) U.S. Water Resources Council

Table 6-2
Population, Employment, Personal Income, and Earnings By Industry, Historical and Projected, Selected Years, 1950-2000
State – Montana

	1950	1962	1980	2000
Population, Midyear	593,000	698,000	720,000	790,000
Per Capita Income (1967s)	2,238	2,468	4,104	7,363
Per Capita Income Relative (US=1.00)	1.08	.96	.86	.89
Total Employment	220,468		262,500	295,000
Employment/Population Ratio	.37		.36	.37
In Thousands of 1967 Dollars				
Total Personal Income	1,327,000	1,723,000	2,955,000	5,817,000
Total Earnings	1,140,083	1,408,292	2,276,700	4,433,600
Agriculture, Forestry & Fisheries	359,832	300,877	242,200	312,500
Agriculture	359,110	299,338	241,200	310,800
Forestry & Fisheries	724	1,539	900	1,700
Mining	61,297	51,766	69,500	110,100
Metal	45,899	29,933	33,800	51,600
Coal	4,303	586	1,200	1,500
Crude Petroleum & Natural Gas	7,398	16,363	24,800	38,500
Nonmetallic, Except Fuels	3,697	4,881	9,500	18,300
Contract Construction	71,638	112,234	141,900	275,300
Manufacturing	90,489	142,635	243,400	449,000
Food & Kindred Products	21,516	25,682	37,400	45,900
Textile Mill Products	0	0	(D)	(D)
Apparel & Other Fabric Products	0	136	(S)	(S)
Lumber Products & Furniture	29,364	48,891	91,400	174,100
Paper & Applied Products	(D)	(D)	(D)	(D)
Printing & Publishing	6,959	10,344	17,000	34,400
Chemicals & Allied Products	2,851	3,127	4,100	6,900
Petroleum Refining	4,442	12,288	15,400	21,400
Primary Metals	16,166	25,346	45,900	72,700
Fabricated Metals & Ordnance	1,115	6,785	11,000	30,600
Machinery, Excluding Electrical		907	2,600	7,200
Electrical Machinery & Supplies		3	(D)	(D)
Total Machinery (1950 Only)	538			
Motor Vehicles & Equipment	130	28	(S)	(S)
Trans. Equip., Excl. Mtr. Vehs.	0	233	1,200	2,800
Other Manufacturing	7,409	6,665	13,600	33,700
Trans., Comm. & Public Utilities	116,510	132,674	202,800	342,600
Wholesale & Retail Trade	198,621	225,162	403,400	796,400
Finance, Insurance & Real Estate	28,103	48,525	91,900	182,900
Services	95,679	149,118	343,300	766,400
Government	117,906	245,291	537,800	1,198,100
Civilian Government	103,542	201,845	476,600	1,095,200
Armed Forces	14,373	43,447	61,200	102,900

Population, April 1, 1970: 694,409
OBERS Projections (1972) U.S. Water Resources Council

Table 6-3
Population, Employment, Personal Income, and Earnings by Industry, Historical and Projected, Selected Years, 1950-2000
State – New Mexico

	1950	1962	1980	2000
Population, Midyear	689,000	978,000	1,119,000	1,336,000
Per Capita Income (1967s)	1,623	2,196	3,844	7,168
Per Capita Income Relative (US=1.00)	.79	.85	.81	.86
Total Employment	216,168		391,100	480,200
Employment/Population Ratio	.32		.35	.36
In Thousands of 1967 Dollars				
Total Personal Income	1,118,000	2,148,000	4,301,000	9,576,000
Total Earnings	936,372	1,792,273	3,394,800	7,403,100
Agriculture, Forestry & Fisheries	145,195	134,046	139,700	162,700
Agriculture	144,159	133,992	139,700	162,700
Forestry & Fisheries	1,037	52	(S)	(S)
Mining	78,185	151,098	177,000	270,000
Metal	23,843	49,507	63,600	97,400
Coal	4,930	1,375	7,000	13,100
Crude Petroleum & Natural Gas	35,963	69,159	68,100	89,000
Nonmetallic, Except Fuels	13,452	31,057	37,300	70,400
Contract Construction	96,390	123,484	221,300	485,600
Manufacturing	54,079	116,236	196,700	417,900
Food & Kindred Products	7,928	19,894	29,000	47,500
Textile Mill Products	(D)	(D)	(S)	(S)
Apparel & Other Fabric Products	213	646	5,200	9,400
Lumber Products & Furniture	9,400	9,470	17,900	30,800
Paper & Allied Products	(D)	(D)	(D)	(D)
Printing & Publishing	5,448	9,164	17,800	40,400
Chemicals & Allied Products	(D)	(D)	4,600	9,400
Petroleum Refining	3,489	5,519	11,200	18,400
Primary Metals	(D)	(D)	(D)	(D)
Fabricated Metals & Ordnance	11,332	24,282	8,700	18,100
Machinery, Excluding Electrical		3,652	10,500	25,300
Electrical Machinery & Supplies		4,020	32,700	89,500
Total Machinery (1950 Only)	226			
Motor Vehicles & Equipment	866	613	3,000	6,700
Trans. Equip., Excl. Mtr. Vehs.	786	19,509	24,100	47,000
Other Manufacturing	3,809	14,642	27,300	69,600
Trans., Comm. & Public Utilities	72,216	134,126	229,800	451,100
Wholesale & Retail Trade	159,075	277,443	514,100	1,144,000
Finance, Insurance & Real Estate	31,735	69,716	139,300	307,600
Services	110,703	325,476	697,800	1,657,900
Government	188,790	460,652	1,078,800	2,505,900
Civilian Government	130,258	354,504	961,000	2,306,300
Armed Forces	58,532	106,147	117,800	199,500

Population, April 1, 1970: 1,016,000
OBERS Projection (1972) U.S. Water Resources Council

Table 6-4
Population, Employment, Personal Income, and Earnings By Industry, Historical and Projected, Selected Years, 1950-2000
State – North Dakota

	1950	1962	1980	2000
Population, Midyear	619,000	637,000	632,000	681,000
Per Capita Income (1967s)	1,743	2,345	3,884	7,047
Per Capita Income Relative (US=1.00)	.84	.91	.82	.85
Total Employment	223,776		232,500	254,300
Employment/Population Ratio	.36		.37	.37
In Thousands of 1967 Dollars				
Total Personal Income	1,079,000	1,494,000	2,455,000	4,799,000
Total Earnings	934,593	1,256,073	1,868,600	3,625,500
Agriculture, Forestry & Fisheries	415,102	472,598	335,400	442,900
Agriculture	415,102	472,598	335,400	442,900
Mining	5,831	12,927	19,100	27,000
Metal	0	14	(D)	(D)
Coal	4,347	2,310	3,700	5,000
Crude Petroleum & Natural Gas	601	9,565	13,100	18,400
Nonmetallic, Except Fuels	883	1,043	(D)	(D)
Contract Construction	52,503	85,580	101,400	200,000
Manufacturing	26,398	35,088	86,100	178,300
Food & Kindred Products	15,231	17,301	26,600	36,800
Textile Mill Products	0	0	(S)	(S)
Apparel & Other Fabric Products	(D)	(D)	(S)	(S)
Lumber Products & Furniture	261	430	1,500	3,400
Paper & Allied Products	(D)	(D)	(S)	(S)
Printing & Publishing	5,513	7,858	13,500	27,700
Chemicals & Allied Products	233	400	1,700	3,600
Petroleum Refining	(D)	(D)	3,500	6,200
Primary Metals	(D)	(D)	(D)	(D)
Fabricated Metals & Ordnance	1,205	1,506	7,500	21,400
Machinery, Excluding Electrical		2,535	17,100	43,500
Electrical Machinery & Supplies		80	(S)	(S)
Total Machinery (1950 Only)	629			
Motor Vehicles & Equipment	611	3	2,200	5,100
Trans. Equip., Excl. Mtr. Vehs.	(D)	(D)	(D)	(D)
Other Manufacturing	2,174	4,491	10,700	26,800
Trans., Comm. & Public Utilities	72,641	81,144	121,800	209,200
Wholesale & Retail Trade	184,613	220,605	374,000	737,100
Finance, Insurance & Real Estate	18,851	39,689	73,400	150,500
Services	63,435	116,833	280,900	645,500
Government	95,221	191,605	476,000	1,033,800
Civilian Government	90,656	146,882	371,500	856,000
Armed Forces	4,560	44,721	104,400	177,800

Population, April 1, 1970: 617,761
OBERS Projections (1972) U.S. Water Resources Council

Table 6-5
Population, Employment, Personal Income, and Earnings By Industry, Historical and Projected, Selected Years, 1950-2000
State – Utah

	1950	1962	1980	2000
Population, Midyear	696,000	959,000	1,231,000	1,592,000
Per Capita Income (1967s)	1,806	2,356	3,992	7,184
Per Capita Income Relative (US=1.00)	.87	.91	.84	.87
Total Employment	230,433		473,400	626,300
Employment/Population Ratio	.33		.38	.39
In Thousands of 1967 Dollars				
Total Personal Income	1,257,000	2,259,000	4,914,000	11,437,000
Total Earnings	1,053,142	1,882,202	3,922,200	8,919,000
Agriculture, Forestry & Fisheries	110,350	66,687	71,400	94,900
Agriculture	109,483	65,322	70,900	94,100
Forestry & Fisheries	868	1,367	(S)	(S)
Mining	72,013	100,310	138,100	226,000
Metal	44,424	66,299	95,900	161,200
Coal	23,162	13,577	15,300	18,600
Crude Petroleum & Natural Gas	1,841	13,678	9,700	12,700
Nometallic Except Fuels	2,588	6,751	17,000	33,400
Contract Construction	82,273	145,996	207,400	469,400
Manufacturing	138,386	378,346	589,500	1,242,100
Food & Kindred Products	37,664	52,448	72,100	117,300
Textile Mill Products	1,111	324	(S)	(S)
Apparel & Other Fabric Products	3,409	7,243	26,900	58,500
Lumber Products & Furniture	4,013	8,854	17,100	34,000
Paper & Allied Products	(D)	(D)	(D)	(D)
Printing & Publishing	9,953	16,358	36,100	82,200
Chemicals & Allied Products	(D)	(D)	(D)	(D)
Petroleum Refining	8,095	9,978	12,200	16,800
Primary Metals	46,516	71,048	99,900	143,800
Fabricated Metals & Ordnance	6,211	53,603	58,800	145,500
Machinery, Excluding Electrical		16,334	68,200	167,900
Electrical Machinery & Supplies		6,551	38,800	113,200
Total Machinery (1950 Only)	4,467			
Motor Vehicles & Equipment	237	739	5,300	10,700
Trans. Equip., Excl. Mtr. Vehs.	258	99,865	80,200	189,300
Other Manufacturing	12,232	25,683	51,700	115,200
Trans., Comm. & Public Utilities	112,520	159,760	297,000	594,300
Wholesale & Retail Trade	214,553	336,150	682,500	1,562,800
Finance, Insurance & Real Estate	36,838	76,141	164,500	380,800
Services	98,371	212,860	623,300	1,620,900
Government	187,841	405,948	1,148,200	2,727,300
Civilian Government	170,515	375,634	1,092,500	2,633,600
Armed Forces	17,326	30,311	55,700	93,700

Population, April 1, 1970: 1,059,273
OBERS Projections (1972) U.S. Water Resources Council

Table 6-6
Population, Employment Personal Income, and Earnings By Industry, Historical and Projected, Selected Years, 1950-2000
State – Wyoming

	1950	1962	1980	2000
Population, Midyear	290,000	332,000	359,000	426,000
Per Capita Income (1967s)	2,300	2,599	4,253	7,420
Per Capita Income Relative (US=1.00)	1.11	1.01	.89	.90
Total Employment	114,715		143,700	171,300
Employment/Population Ratio	.40		.40	.40
In Thousands of 1967 Dollars				
Total Personal Income	667,000	863,000	1,527,000	3,161,000
Total Earnings	558,595	691,270	1,196,300	2,434,800
Agriculture, Forestry & Fisheries	109.161	78,084	81,200	107,000
Agriculture	108,847	77,598	81,100	106,800
Forestry & Fisheries	316	487	(S)	(S)
Mining	53,799	69,812	130,800	204,500
Metal	1,135	12,380	27,000	46,800
Coal	19,377	2,637	2,700	3,400
Crude Petroleum & Natural Gas	30,679	48,309	81,000	115,000
Nonmetallic, Except Fuels	2,649	6,487	20,000	39,100
Contract Construction	45,450	69,982	90,000	186,100
Manufacturing	34,034	50,374	78,900	172,500
Food & Kindred Products	6,315	8,677	11,300	16,900
Textile Mill Products	(D)	(D)	(S)	(S)
Apparel & Other Fabric Products	0	30	(S)	(S)
Lumber Products & Furniture	3,839	5,257	9,000	14,600
Paper & Allied Products	0	0	(S)	(S)
Printing & Publishing	4,228	3,933	6,600	13,700
Chemicals & Allied Products	125	1,376	2,800	7,500
Petroleum Refining	14,156	20,402	24,900	39,300
Primary Metals	(D)	(D)	(D)	(D)
Fabricated Metal & Ordnance	640	1,159	4,400	27,900
Machinery, Excluding Electrical		546	5,800	15,000
Electrical Machinery & Supplies		196	(S)	(S)
Total Machinery (1950 Only)	107			
Motor Vehicles & Equipment	0	314	(S)	(S)
Trans. Equip., Excl. Mtr. Vehs.	0	1,420	1,600	11,600
Other Manufacturing	4,626	5,314	9,400	21,400
Trans., Comm. & Public Utilities	72,021	79,652	113,200	200,500
Wholesale & Retail Trade	99,660	112,496	182,700	380,100
Finance, Insurance & Real Estate	14,585	21,816	42,000	87,600
Services	41,142	77,560	164,400	388,700
Government	88,741	131,493	312,700	707,400
Civilian Government	59,857	110,794	276,800	646,900
Armed Forces	28,881	20,697	35,900	60,500

Population, April 1, 1970: 332,416
OBERS Projections (1972) U.S. Water Resources Council

Coal represents a large segment of this Nation's wealth and as such influences political, social, and economic thinking and actions. Steady employment at a good wage for the miners of coal and a profitable operation for the coal mining companies provide local, state, and Federal governments with a tax base that can be used to finance the social, community, and government services for the benefit of the country. Social welfare, old age benefits, community and national health programs, education, and cultural facilities and programs such as libraries and theater groups can benefit from the revenues derived from an economy stimulated and sustained by coal.

Mining communities often reflect strong ethnic concentrations in their populations. The existence and subsequent mixing of these people with the dominant culture group could be a positive value for its horizon-widening effects on the country's sensitivity to cultural diversity. Cultural and ethnic mixing have often produced the hybrid vigor we recognize as the distinct American culture, although resistance to non-native population influx can also create polarization and negative social effects.

The enormous private and Federal coal reserves in the Northern Great Plains and Rocky Mountain Coal Provinces unquestionably will provide the basis for the establishment or enlargement of permanent communities. With proper cooperation in comprehensive regional and community land-use planning, there is every reason to believe that population centers will provide social, cultural, and educational advantages that depend on stable industries and steady employment. Employees of modern coal companies typical of those operating in these coal provinces are highly skilled equipment operators, scientists, engineers, and managers. Well paid and well educated, they may be instrumental in initiating changes in the social norms of a community as well as the introduction of new community services. The key to achieving desired amenities in expanding communities is early and foresighted planning by coal companies, municipal leaders, officials of State and Federal agencies, and the residents themselves, who can rely on the stability of their community because of expanding demands for the energy provided by the coal they mine.

LOSS OF NONCOAL VALUES

The length of time that coal exploration, development, production, and rehabilitation alters the prior environment and modifies other uses will vary from a few years to possibly hundreds or thousands of years.

Topography will be permanently changed in varying degrees. This could preclude production of vegetation over a long period of time if the new topography is more susceptible to erosion than the old. Active erosion makes vegetal establishment more difficult and reduces the productive capacity of the soil. On the other hand, more regular and gentle slopes, once revegetated, would erode less.

Loss of long-term productivity due to subsidence into underground mines will be localized, but cannot be predicted. Subsidence may affect long-term productivity of surface and subsurface water resources, soil, vegetation, wildlife, various land uses, and human value resources. Soil productivity loss and that of soil-dependent resources usually is greater in steeper terrain.

Air pollution, including carbon dioxide from coal-fired plants, added to those produced by man's other activities, could modify local climates.

Surface water quality and quantity may be adversely affected by sedimentation and greater fluctuations in surface runoff until the predisturbance density of ground cover is reestablished. Long-term productivity will be reduced where the sediment originates as well as where it is deposited, especially if the sediment contains toxic substances.

Long-term productivity based on preexisting quality of ground water aquifers may be reduced if aquifers are contaminated due to mining operations. Where pressure of an aquifer is reduced, reduction of dependent productivity will be permanent. Disruption of an aquifer by either surface or underground mining may permanently affect water availability and pumping costs.

Waste piles and settling ponds concentrate minerals in new locations in the environment.

Trace elements in fly ash deposited in the vicinity of coal-fired plants have some effect on the productivity of the affected area, dependent upon the quantity and toxicity of the deposits.

Use of water by coal-fired, mine-mouth, generating plants will reduce or enhance productivity of other water-using activities, i.e., recreational, agricultural, municipal, manufacturing, etc., proportional to the amount of water used by the generating plants and the change in temperature of the watercourse receiving plant discharge. Water used in the cooling process at coal-fired plants will be warmed. Warmed water will be less productive for some organisms, but more productive for others.

A net loss in aquatic production because of less total water available for the habitat is predictable.

The natural soil will be disturbed, eroded, compacted, or mixed with spoil during mining. Severity will range from slight compaction to destruction of the soil's productivity. Reductions in long-term productivity of vegetation will vary with climate and the degree of soil disturbance, compaction, or intermixture with spoil.

Steinbrenner (1963) listed several soil factors that were significantly correlated to productivity, expressed in terms of site index, of Douglas fir in the Pacific Northwest. Site index was defined as the total height to which a dominant tree grew in an arbitrary period, in this case, 100 years. His findings show the importance of the entire soil profile (surface soil, subsoil, and weathered parent material) to productivity. They are applicable in varying degree to soils everywhere.

Total Soil Depth

A linear relationship exists between total soil depth and site index. A soil that is 20 in. deep has a site index of 90. A 40-in.-deep soil has a site index of 106. Thus, each inch of total soil depth over 20 in. is responsible for 0.8 ft of site index.

Gravel Content

Coarse rock fragments in the soil lower the site index, but more frag-

ments lower the site index less. Gravels and stones do not retain available water for plant growth and the available water capacity of the site is decreased. The capacity to supply plant nutrients is also decreased. An increase of coarse fragments from 0 to 20 percent reduces the site index by 20 ft. If coarse fragments comprise from 20 to 40 percent, site index is reduced an additional 10 ft. Forty to 60 percent coarse fragments only reduce site index an additional 3 ft.

Depth of Surface Horizon

The surface soil layer is very important to plant growth. It is literally the plant nutrient-producing factory. It is biologically, chemically, and physically the most active portion of the soil profile. Most feeder roots are located in the surface horizon. It is where the all important, active, organic soil fractions and plant nutrients are located. The surface horizon is the first soil layer that is eroded, disturbed, or cast aside.

Most soil where Douglas fir grows have surface horizons that are between 4 and 10 in. thick. The data show that each inch of surface horizon in this range is responsible for 5 ft of site index. Site indexes were 109 and 140 for 4- and 10 in.-thick surface horizons, respectively.

The importance of these site differences is shown by the yield tables from USDA Bulletin 201 (McArdle, 1950). At age 100, the normal yield tables at a site index of 140 show 62,800 board feet. At site 135, with a loss of 1 in. of topsoil, the yield drops to 57,600, a reduction of 5,200 board feet.

Sindelar, et al., 1973, also showed that depth of topsoil was significant to productivity. They reported that 16.18 grams per square meter of vegetation grew where there was no top soil (0 in.) and 32.35 grams per square meter grew where there was 4 in. of topsoil over the spoil.

Texture of Subsoil Horizon

There is a positive curvilinear relationship between site and clay content of the subsoil horizon. The positive effect drops off when the clay content becomes so great that root penetration is impeded.

The site index increases 7 ft as clay content in the subsoil increases from 10 to 20 percent. The site index increases 6 ft more as clay content goes from 20 to 40 percent. The positive relationship almost ceases at 45 percent clay.

This relationship exists because an increase in clay content increases the available water-holding capacity of the soil. Also, most cation changes occur in clay and organic matter, and that process affects soil fertility.

Macroscopic Pore Space

The importance of macroscopic pore space lies in air and water movement within the soil. When pore space is high, there is a straight line, negative relationship between site and percent macroscopic pore space in the subsoil horizon. The site index decreases 20 ft as macroscopic pore space increases from 10 to 30 percent. This is one foot of site for every 1-percent increase in pore space. This is explained by the fact that available water-holding capacity and nutrient reserves decrease because the percent macroscopic pore space increases.

When macroscopic pore space is low, an opposite positive relationship is true.

Root penetration ceases at a macroscopic pore space less than 6 percent. Roughly, the site index drops from 126 at 6 pecent to 90 at 5 percent. This shows what happens when soil is compacted.

Steinbrenner (1953) reported that one pass with an HD20 tractor with blade and crawler arch reduced the macroscopic pore space from 18 to 11 percent on a wet soil. Infiltration rate in cubic centimeters per minute decreased from 83 to 12 on the same samples.

In the wetter, more favorable biomes, vegetation can be reestablished within a few years. In many arid areas, however, vegetation may not be produced in predisturbance quantity and quality for several centuries.

Wildlife dependent on natural conditions will be affected by loss or reduction of water supply, food, and cover, including solitude, for short periods in wetter provinces and biomes and longer periods in the driest. The seriousness of impacts on populations will depend on the scarcity of the habitat components affected and species involved.

If the entire native environment of a threatened species of wildlife were to be destroyed, the species would become extinct. That this might happen is quite unlikely, however.

Agricultural production will be eliminated during site occupancy for coal production. It may subsequently be reduced in quantity and quality because of soil disturbance. For example, land capable of producing high yields of corn may for some time produce only low or moderate yields of wheat or grass for pasturage. In other cases, low-producing, rough lands may be smoothed and converted to improved pastures.

Timber production may be delayed only during the time sites are actually occupied for coal production. Or it may be set back further, if young timber with no merchantable value is removed and a new stand must be planted. In any case, depending on the degree of soil disturbance, production will be modified because of changed conditions.

Livestock forage production will be lost during the occupancy period for coal mining and the period required for the revegetation. The quantity and quality of livestock forage following mining will depend on the success of revegetation.

Wild horse and burrow populations will move from the area during occupancy and may return as soon as forage is again available.

Recreational pursuits will be modified during mining operations. For example, hunting may be diminished, but the mining operation itself may provide considerable recreational interest to geologic buffs and rockhound enthusiasts.

In areas with sufficient water resources, recreation may be enhanced following rehabilitation if water bodies suitable for fishing and other sports are created where none existed before.

Before disturbance, historical and archeological evaluation should be undertaken to minimize losses. Most of the value to mankind from learning

of his past can be salvaged. However, something of value will unavoidably be lost in all cases. Only conscientious historians and archeologists can determine when the quantity of information gained will be nearly that which would have been gained had there been unlimited time for evaluation and study.

The esthetic qualities of coal-mined areas will be changed most drastically in areas with steep topography and 6 in. or less of precipitation. Before commitment of an area to coal mining, other developments proposed for adjoining or nearby areas must also be considered. Coal mining may disturb relatively small areas at any one time if rehabilitation is done as soon as possible. However, for example, gypsum mining may take place to the north. Breaking of virgin ground for grain production may occur to the south. Timber harvest may commence to the west. An interstate highway may go through on the east. If sagehen strutting grounds and range are diminished, the number of sagehens will decrease. If the solitude required by elk is eliminated over the area, elk will depart. In combination with environmental impacts from other sources, the added impacts from coal mining could be more serious than if they were the only ones on the landscape.

This summary of environmental losses (which have been described in more detail earlier in the statement) indicates that certain losses of noncoal values can be anticipated when coal is mined. Placing dollar values on such environmental losses is difficult in most cases and impossible in some. However, before any dollar values can be calculated, it must first be known which and how many acres are affected. The precise nature of impacts and their dollar values can be determined only when a specific mining proposal is precisely examined. That step is taken by interagency, interdisciplinary teams making environmental analysis in connection with applications for prospecting permits and preference right coal leases, in considering prospecting and mining plans, in determining the feasibility of competitive coal leasing, in developing stipulations to be incorporated in coal leases, in administering coal leases, in directing rehabilitation measures, and in assessing any unmitigated impacts that remain after all requirements have been met and leases are terminated.

Impacts that cannot be reduced must be weighed against the values the land has following rehabilitation and the benefits derived from the coal that was mined. The $2,347,636 which the Federal Government was paid in 1972 for Federal coal represents only a small fraction of the total converted value of the 10,222,411 tons extracted.

According to 1973 estimates, there are 21,995,000,000 tons of recoverable coal in 1,075,992 acres under Federal coal leases and preference right coal lease applications. That represents about 20,000 tons of recoverable coal per acre. If as predicted, production of Federal coal nearly quadruples by 1975 to 38,900,000 tons per year, the Federal land mined each year can therefore be expected to be about 2,000 acres per year.

Rehabilitation costs vary widely, from several hundred to several thousand dollars per acre. Assuming that rehabilitation costs $5,000 per acre, the total annual cost to the lessees for rehabilitating 2,000 acres of Federal land mined would be $10,000,000. That is more than four times the Federal income in 1972 from coal leasing, but less than one-fifth of the mine-mouth value of the coal mined that year.

If rehabilitation costs average $1,000 per acre, the cost for 2,000 acres per year would be $2,000,000, or less than 4 percent of the mine-mouth selling price of the coal.

Accurate estimates are not possible, but the difference in value of the land before mining (excluding coal values) and after rehabilitation would represent the noncoal losses in value attributable to mining. There are wide ranges in land values, of course, but if for example land valued at $100 per acre suffered a 25 percent loss in value, the loss would be $25 per acre. Applied to 2,000 acres mined annually, the loss would be $50,000, or less than one-tenth of 1 percent of the mine-mouth value of the coal.

Lands with depreciated values caused by mining tend to regain their former values as unmitigated environmental impacts ameliorate with the passage of time. This complicates a direct comparison of the land's long-term value with the present worth of the coal when mined, plus the longer lasting pension funds and the schools, hospitals and other public benefits supported by the revenues related to the coal. Suffice it to say that carefully located and planned extraction of Federal coal, with accompanying rehabilitation, generally produces values in excess of the immediate loss of noncoal values plus the long-term loss in productivity of the rehabilitated land.

LAND USE FOLLOWING COAL MINING

Under the terms of a Federal coal lease, the United States of America, the lessor, through the BLM, grants coal-mining privileges, and the lessee agrees to certain conditions, including the provisions of regulations of the Secretary of the Interior applicable when the lease is issued and all revisions thereafter.

Among the standard conditions of a coal lease (Form 3130-1, October 1967), is the agreement of the lessee "to the extent deemed necessary by the lessor to fill any sump holes, ditches, and other excavations, remove or cover all debris, and so far as reasonably possible, restore the surface of the leased land and access roads to its former condition, including the removal of structures as and if required." Federal resource management agencies with administrative jurisdiction over land to be mined prescribe specific stipulations to be incorporated in Federal coal leases to protect the purposes for which the lands are managed.

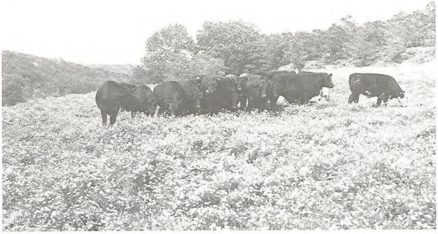
Among such stipulations are those designed to achieve rehabilitation of the land to accommodate the planned uses of the land following mining. In most cases, the uses of Federal land after coal is mined will be similar to the uses before mining.

Most of the Federal coal is in the Rocky Mountain and Northern Great Plains Coal Provinces. The dominant surface uses, by acre of Federal lands in those two provinces are for livestock forage production, wildlife habi-

tat, as watersheds, for wide-ranging recreational activities, and for timber production.

In Montana, Wyoming, Colorado, New Mexico, and Utah there are 138 million acres of Federal land. Half of that land is managed by the BLM and half by other Federal agencies.

Disruption of prior uses of Federal lands in those states by coal mining each year is very small, about one-thousandth of 1 percent. Consequently, the impact of mining on other land uses is proportionately very small as a whole. However, on the acres where mining occurs, the impact is very important, particularly since effects of impacts remaining after rehabilitation may be evident for several to many years thereafter.



Rangelands formerly used for grazing can again be used for that purpose.

With appropriate rehabilitation, Federal lands from which coal has been mined can again be devoted to other uses.

Rangelands formerly used for livestock and wild horse forage production and as habitat for wildlife of various species can again be used for those purposes. The quality of the rehabilitated rangelands will depend on several factors. These include the condition of the surface soil, season and amount of rainfall during the first several years following revegetation, management of use by livestock, appropriateness of the plant species and fertilizers used in revegetating the area, reentry of other native species, wind and water erosion, and maintenance treatments.

The use of lands as watersheds continues during mining operations as well as after. Even in areas of relatively high rainfall, such as in Ohio and western Washington, it has been demonstrated that erosion during surface mining operations can be controlled so that water leaving the disturbed area is clear. This is accomplished through design of the mining operation, drainage management, use of flocculants, settling basins, and the filtering effect of growing vegetation. In some water-short areas, the land is intentionally denuded to produce greater runoffs from watersheds. Consequently, the water management objectives in each locality must be considered in planning for the quality and use of water from areas that are being or have been mined. Water management measures can be applied in most cases to produce the desired results. Timely enforcement of water management stipulations in coal leases is essential.

Opportunities for enhancing recreational interests sometimes result from coal-mining operations. Road and utility distribution lines built to serve coal mining operations sometimes can be used for recreational activities, particularly if they were planned with that in mind. Such facilities also may be useful for range or forest fire control or for other aspects of resource management, particularly in remote areas. Since many areas have a shortage of water-oriented recreation, there are instances when planned excavation and site improvement can provide for boating, fishing, and improvement of wildlife habitat. Spoil piles can be shaped to provide attractive recreation sites. In some instances mounding provides topographic variations and interest in an area of uninteresting relief. Mining excavations, both during and after mining operations, provide recre-

With proper rehabilitation, this land, from which coal has been mined, could be devoted to other uses.

ational interests, even though the former esthetic quality of the area may have been altered. In mountainous areas, particularly, roads to former mines can be converted to hiking trails if rehabilitation has insured that the mined areas are safe for hikers.

In the Rocky Mountain and Northern Great Plains Coal Provinces, surface mining on Federal lands will occur mainly in nonforested areas. On the other hand, forested terrain is generally such that if coal is mined, it will be by underground methods. Consequently, except for areas disturbed at mine portals and plant sites, the principal effect on existing forests will be from subsidence. Further forest production will depend on the nature of the residual stands. In other coal provinces that support coniferous stands like those on the Pacific Coast or hardwood stands as in the Eastern, Interior, and Gulf Coal Provinces, production of future stands of merchantable timber on Federal lands where coal has been mined is a distinct probability. Though the acreage of Federal coal lands in those provinces is quite small, opportunities are good for various other land uses following mining, also.

Mined land reclamation must be undertaken which will return the area to its most beneficial and desirable condition following mining.

The Surface Managing agency must be given this responsibility and directed to evaluate the rehabilitation needed to conform as nearly as possible to plans for resource management of the surrounding area.

Chapter Seven

Irreversible and Irretrievable Commitments of Resources If Federal Coal Is Leased

Irreversible and Irretrievable Commitments of Resources If Federal Coal Is Leased

Some irreversible and irretrievable commitments of resources occur if Federal coal land is leased, explored, developed, mined, and rehabilitated. These include coal extraction and use, changes in land use, alteration of wildlife habitat, and modification or destruction of certain human-value interests. Some such consequences may remain after maximum mitigation efforts.

COAL EXTRACTION

The principal commitment in the Federal coal-leasing program is for the extraction of coal from the ground. Since coal is a nonrenewable resource, once it is mined and has been used, it is gone and cannot be replaced. The commitment to mine coal involves not only the coal that is mined, but the coal that is lost in the process. An average of about 85 percent of the coal resource can be recovered when the area strip-mining methods are used. In contrast, only half of the coal, on the average, can be saved in underground mining. Especially when seams are thick, coal must be left to support the ground above the seam being mined. Otherwise, recoverable coal in seams above may be lost because of disruptions caused by subsidence.

Cumulative production of Federal coal from 1780 through 1972 amounts to 277,973,915 tons. An additional 15 to 50 percent of this cumulative production may have been wasted in the mining process. In 1972, Federal coal production was 10,222,411 tons, which was 1.7 percent of the total production in the United States.

LOSS OF NONRESTORABLE SURFACE VALUES

Ecological Interrelationships

Occasional situations occur in which the natural ecological balance is damaged beyond repair by coal mining. One example is the exposure of bedrock by mass soil movement, where restoration of a life-sustaining abiotic environment can be accomplished only by natural processes operating over a period of geologic time. Loss of the soil mantel would mean loss of vegetation, which would affect the habitat of wildlife using it.

Geology and Topography

The major irreversible impact on the geology of the area from coal mining would be the possibility of subsidence or earth movements, which also would alter the local topography.

Climate and Air

Theoretically, properly conducted coal operation should have no irreversible or irretrievable effects upon the atmospheric resource. Corrective measures required by coal lease terms should reduce adverse effects to a level within the natural capacity of the atmosphere to purify itself. In the interim, operating equipment will consume oxygen, and carbon dioxide and other gases will be released into the atmosphere.

Hydrology

Extraction of coal by either underground or surface methods may disrupt water resources. This is particularly true where there is destruction of clay-shale encompassing the coal seam or an impermeable layer between coal seams which prevents the percolation of water through it. Permanent changes in head relationships and flow patterns in aquifers could reduce ground-water supplies, increase pumping costs due to lowered water levels, or impair the water quality from a usable aquifer. Usable aquifers could also be permanently damaged by pollutants introduced during mining operations. Changes in the hydrologic regimen of aquifers could also affect the quality and discharge of nearby springs and streams. Where coal beds are used locally as sources of ground water, removal of the coal permanently removes a useful aquifer. Increased sediment loads to streams resulting from coal-mining operations may shorten the useful life of reservoirs downstream from the mines.

If water is committed to coal production and utilization processes, it then becomes unavailable for other uses. Since the supply of water varies from place to place, its commitment to mining is of variable importance to other possible uses. Water that is consumptively used and not returned to normal watercourses is no longer available to other purposes.

Soil

Soil organisms will recover following soil disturbance to the degree that the soil in which they live is rehabilitated. Erosion irreversibly reduces the environment on which the organisms are dependent.

Any action that results in landslides or soil erosion has a permanent impact

on the soil. The magnitude of the loss depends upon the severity of the erosion. A long term commitment of the natural soil is made in areas where roads, railroads, structures, and waste disposal sites exist.

Vegetation

Areas surface mined may remain bare of vegetation for prolonged periods of time. Required revegetation measures, in conjunction with natural recuperation, can be expected to restore sites in the more moist areas. Disturbed arid areas are incapable of regenerating plant life except over long periods of time. The long time necessary to restore vegetation in some areas is evidenced by the fact that segments of the Salt Lake City to Los Angeles wagon trail, used in the mid-1800s, is still devoid of natural vegetation. Arid areas receiving less that 6 inches of precipitation annually may be devoid of natural vegetation for hundreds of years. There have been several recent successes in revegetation by use of irrigation to stimulate natural plant growth in arid areas, for example at Colstrip, Montana and the Navajo Mine, New Mexico.

Extinction of endangered species if present, such as the Joshua tree or the bristlecone pine would be irreparable. Loss of vegetative production, be it corn, grass, or trees, during the time the area is out of production is irretrievable.

Loss of ground-water aquifers could permanently dry up aquatic habitat resulting in an irretrievable loss of aquatic vegetation in small springs or lakes, especially, in the arid and semi-arid areas.

The natural process of the conversion of standing water habitats to land masses is accelerated by various actions of coal operations that contribute to sedimentation. Massive earth slides as have occurred in some Appalachian areas are the most drastic events in localized areas, but the cumulative effect of increased sediment from other actions can cause the greatest off-site effects on aquatic plants.

Aquatic vegetation destroyed by road and railroad construction at water crossings would generally constitute a minor irretrievable loss of vegetation if plants could not be re-established.

Joshua tree.

Wildlife

The loss of any endangered species constitutes an irreversible and irretrievable commitment. Small, nonmobile species dependent on a limited habitat with only local distributions, such as the Siskiyou Mountain salamander, are especially vulnerable. Other more mobile species, such as the northern spotted owl and Columbian white-tailed deer, could be eliminated from an area for a long period of time.

Discovery of coal and subsequent mining operations may result in permanent urban development. The loss of habitat and attendant human activity could result in the loss or displacement of major game species and the larger predatory birds and animals.

Heavy industrial and domestic use of water may lower water tables and drain marshes and other wetlands. Waterfowl, other birds, amphibians, and small mammals formerly inhabiting these wetlands may be displaced to other areas or permanently lost.

Vegetation removal and soil disturbance associated with coal operations can cause siltation of bays and estuaries and permanently damage the habitat for birds, marine animals, and invertebrates if erosion prevention requirements are violated.

Excessive sedimentation in violation of lease terms could cause irretrievable changes in aquatic habitat when stream channels, lakes, marshes, or reservoirs become filled with sediment. The habitats would no longer be capable of producing the quantities of fish they once did, unless the sediment is physically removed, which is generally considered impractical.

While other activities in watersheds may contribute to increased sedimentation, coal mining operations might accelerate sedimentation of surface waters. Massive earth slides caused by activities in steep terrain are the best illustration of the adverse effects of heavy sedimentation in a localized area. Aquatic habitat lost to sedimentation is seldom restored by natural processes. Loss of productive area in estuaries due to accelerated sedimentation is another example of an irreversible commitment of aquatic resources.

Extermination of an endangered species or subspecies of fish is an irretrievable or irreversible action. Most endangered fish species in the western United States are found living in sometimes harsh, isolated, small habitats. These endangered species could be made extinct through direct eradication by loss of water supply or ground-water contamination. In these cases, the habitat could eventually recover, but the species would be lost.

Endangered fish could also be lost by habitat changes that the species could not adapt to, such as extensive sedimentation of a small spring or pond.

Land Use

Coal-mining operations have their greatest impacts in areas that are in a natural or near natural condition. Natural ecosystems can be altered in the immediate area to the extent that restoration is either completely impossible, or not feasible. In any case, restoration to precisely the original situation is impossible. The significance of the loss depends on the uniqueness of the area or resource areas. Recreational activities that depend on the uniqueness of a site or area would be irreversibly eliminated.

Urban land uses resulting from coal mining nearby will establish enduring patterns and trends.

Population Patterns and Considerations

Community life and social patterns are altered by population increases and economic growth caused by coal mining operations. Although prior economic activities might return after operations ceased, if no new economic activity is developed during coal mining activities, it is doubtful that social aspects would ever return to the premining conditions. Generally, most cultural, ethnic, and religious values are durable features that will transcend such impacts as coal mining.

Human-Value Resources

Esthetics. If properly planned and carried out, careful mitigation and rehabilitation measures should be able to nearly restore esthetic values in many areas. The length of time necessary for restoration would vary greatly. Certain areas of the desert and tundra require such long periods to recover that esthetic losses could be considered irretrievable for all practical purposes. Other areas, such as steep slopes where earth slides occur during operations, may never be retrieved.

Geologic. Coal mining may represent an irreversible or irretrievable commitment of geological values of human interest. Massive surface disturbance could eliminate small, fragile geologic features such as natural archways, etc., if those areas are not excluded from mining.

Archeologic. Archeological excavation represents a use that alters the resources as it is excavated and salvaged. If archeological exploration hastily precedes coal mining, there is the chance that maximum values of more deliberate work would not be attained.

Historic. Historic structures and sites are unique and irreplaceable. Once destroyed or impaired, such structures and sites are never the same, and the more they are impaired, the less reality they project for the visitor. Impairment can be a cumulative thing so that after a long period of time nothing really original or authentic exists. Much of the understanding of what happened in the past is related to the present similarity of the site to its appearance at the moment of historical importance. Restoration and reconstruction are effective measures, but it must be recognized that those approaches are not as satisfactory as dealing with the original structure or site.

Chapter Eight

Alternatives

1. Energy Source Options

This section will focus on the environmental impact of alternatives to the Federal coal-leasing program. The following are discussed: energy source alternatives, energy conservation, administrative alternatives within a Federal coal-leasing program. Some of these options are not mutually exclusive, but could be carried out in conjuction with the current coal-leasing program, to help meet projected U.S. energy needs.

ENERGY SOURCE OPTIONS

The energy sources set forth in this section of the report can help offset the loss of production from any reduction or elimination of the Federal coal-leasing program. Many of these alternatives, such as oil and gas leases, are already contributing to U.S. energy supply, while others, such as the use of winds or tides to generate energy, are longer-term future sources. Together they form the current and potential mix of energy sources.

In considering alternative sources of energy, it is important to investigate the ability of one source of energy to substitute for another in various uses. Some substitutions can be made by the large power producer at generating plants and in the home by the consumer, but there are areas where no substitutions can be made.

The largest, and at the present time, the only growing consuming sector is the electric utility industry. Almost two-thirds of current coal production is used to generate electricity. The following table shows U.S. consumption and exports of coal. Although coal's use in total electric power generation has increased in recent years, oil consumption in this sector has increased faster. Thus, the largest potential expansion of the coal market is in electrical generation. Development of coal gasification and liquefaction technologies could enable coal to be used in applications that require gaseous and liquid fuels.

This section will first discuss electrical generation and then alternative fuels and sources of energy. (Refer to Table 8-1.)

Substitutability in Electrical Power Generation

Electric utilities presently account for about 25 percent of the primary energy consumption and, according to some projections, will account for 40% of total U.S. primary energy consumption in 1985. The total capacity of the electric power industry at the end of 1973 was 432 million kW, as compared to 236 million kW at the end of 1965. The energy sources used to generate electricity in 1972 were:

Coal	44%
Natural Gas	21%
Oil	16%
Hydroelectric	16%
Nuclear	3%

There are wide differences between regions in the types and amounts of primary energy used in producing electricity. The East North Central and East South Central regions depend heavily on coal (75% to 100%). The South Atlantic and West North Central area also depend principally on coal (50% to 75%). The West South Central depends mostly on natural gas, the Pacific region on hydroelectric power, and New England on oil. The Mountain States region uses a variety of fuels.[1] the substitutability of different sources of energy in electrical generation depends on several factors such as cost, plant and equipment design, geographical location, availability of different types of fuel, availability of water, environmental considerations.

Although nuclear power will account for a larger share of electrical generation in the next few decades, short-term substitutability of fuels for power generation is limited to gas, oil, and coal. Most boiler fuel power plants can convert from coal to oil with a lead time of 6 months or more if (1) the equipment is available, (2) there is room in the plant to install the new equipment, (3) the Btu's are generated by the fuel substitute to efficiently heat the boiler, (4) adequate supply sources are available to warrant changing over to handle new fuels, and (5) it is economically feasible.

Some Eastern power plants can burn both oil and coal. For some such plants conversion to 100 percent coal or 100 percent oil would only involve a matter of weeks. Many other plants, however, are designed to run only on coal or oil. For these plants, extensive modification involving 6 months to a year would be necessary to make the conversions.

The trend in new generating units is to move towards steam electric units with high substitutability of fuels. Coal-fired units are less flexible but can produce electricity with less lead time than nuclear plants. With environmental concerns, the trend has been to use oil instead of the higher sulfur-producing coals. Plants designed for all-coal fuels cannot readily convert to use oil or gas.

Geothermal steam equipment is specialized, consisting of low-pressure turbines unsatisfactory for conversion to some other fuel type.

Generation costs for conventional boiler systems are shown in Table 8-2.

[1] Federal Energy Administration, Project Independence Report, November 1974, p. 119.

Table 8-1
Domestic Consumption and Exports of Coal in 1965 and 1974*

	1965		1974	
	Tons (million)	Percent of Total	Tons (million)	Percent of Total
Electric power	245	47%	388	63%
Coke plants	96	19	90	15
Other industrial	104	20	64	10
Retail	22	4	9	1
Total Domestic Consumption	467	90%	551	89%
Exports	52	10	60	10
Imports	–	–	2	1
Total Domestic Consumption and Exports**	519	100%	613	100%

*Source: Bureau of Mines.
**The difference from production levels is coal in transit and changes in inventory.
Table from: Federal Energy Administration, Project Independence Report, November 1974, p. 13.

Table 8-2
Generation Costs
for Steam Power Plants
(mills per Kwh)

	Coal	Oil	Gas
Power plant (capital costs)	4.05	3.38	2.25
Fuel	3.14	4.04	4.58
Fuel storage	0.8	0.4	–
Operation and maintenance	.39	.21	.24
Total	7.66	7.67	7.07

Source: Olmstead, Leonard M. (1971) "17th Steam Station Cost Survey." Electrical World (November 1, 1971), as cited in Council on Environmental Quality (1973) *Energy and the Environment: Electric Power.*

Substitutability of fuels is affected by geographic location and by what fuel sources are close enough to allow economic transportation to the point of use. High electrical transmission costs generally make it uneconomical to produce power at a great distance from the consuming region. Thus, it is not always economical to produce electricity from a locally cheap and abundant fuel in the absence of a nearby market. The costs of transmission of electricity and transportation of coal restrict the use of Western low-sulfur coals on the east coast. Research effort is studying different methods of transmission of electricity.

Lead time and changeover time are important considerations in whether one energy source can replace another. Substitution of one fuel for another in existing plants involves changeover time where production would cease to exist for a particular unit. Lead time is the time lapse between any initial action to obtain new energy production and the resulting new production. Long changeover times could prevent substitutions entirely if high demand required a particular power unit to stay in production. The above conversions are not necessarily reversible. After being idle for long periods of time, rusty or deteriorated equipment cannot always be reused. In addition, changing price structures of fuels and environmental considerations as to the amount of sulfur in the fuel add to the difficulties inherent in any decision for changeover in fuels. In 1973, oil and gas shortages were dictating the reversal of as many previous conversions from coal to oil as possible. Gas-fired plants in the Southwest must look to coal for conversion as gas and oil supplies diminish.

Environmental considerations are becoming increasingly important in substitutability of fuels. Power plants are responsible for about 12 percent of the estimated nationwide total airborne pollutants in 1968, although they were the largest contributor of sulfur oxides.

Proposed environmental legislation to limit power plant intake fuel to 0.7-percent sulfur would greatly reduce Eastern air pollution, but many plants now using 2.5-percent sulfur fuel would be forced to make substitution to a lower sulfur fuel, if available, or in some cases abandon their operations entirely. Mine-mouth plants in remote Eastern areas are an example, since they are faced with the geographic dilemma of high transportation costs as a result of transmission distance, coupled with a diminishing supply of oil and gas at any price, and a changeover time of 6 months or a year to make a conversion.

Table 8-3 shows major residuals for electrical generation plants of different types.

Substitutability almost invariably requires large capital investment and cannot be justified on cost savings of one fuel substituted for another alone, since this is just one of the factors considered. Cleanliness and controllability are also primary factors in preference for a fuel type.

Another important factor to be considered, particularly important in view of energy shortage, is the technical efficiency of various fuels. By observing the different quantities of energy needed to accomplish the same task, a direct comparison in substitutability potential for various sources of energy in each use sector can be made.

Future substitution between the fossil energy forms, synthetic oil and gas, methanol, nuclear, geothermal, hydroelectric, and other experimental forms such as hydrogen, is a certainty. The extent of this substitution will basically reflect the needs of the times, the supply and demand functions of the energy sources, technology, and

Table 8-3
Annual Major Residuals for 1,000 Megawatt Electrical Generation Plants

Description	Primary Efficiency	Nitrogen Oxides (10^3 Tons)	Sulfur Oxides (10^3 Tons)	Particulates (10^3 Tons)	Thermal (10^{12} Btu's)	Solid (10^3 Tons)	Source*
Coal: Conventional steam No controls	38	23.2	127	207	31.1	64.9	H
Oil: Conventional steam No controls	38	21.1	47.3	1.6	31.1	0	H
Gas: Conventional steam No controls	38	11.2	.02	.43	31.1	0	H
Eastern Coal: Conventional Boiler with wet limestone scrubbing	35	19.2	16.0	3.2	0	955	B
Eastern Coal: Conventional Boiler with magnesium oxide scrubbing	35	19.2	16.0	3.2	0	410	B
Western Coal: Conventional Boiler with wet limestone scrubbing	35	25.0	5.1	2.2	0	487	B
Physically Cleaned Eastern Coal: Conventional Boiler with wet limestone scrubbing	35	17.6	6.4	1.4	0	417	B
Coal: Steam plant with controls	38	23.2	19.1	2.6	0	1,009	H
Northern Appalachia Coal: Atmospheric Fluidized Bed	37.2	4.2	10.1	.5	0	355	H
Northwest Coal: Atmospheric Fluidized Bed	37.2	4.2	3.4	.3	0	241	H
Northern Appalachia Coal: Combined-Cycle Pressurized Fluidized Bed	35.8	4.22	13.2	0.8	0	362	H
Low-Btu Gas (Northern Appalachia Coal): BuMines-Atmospheric Boiler plant with controls	38	0.391	28.8	7.38	0	0	H
Low-Btu Gas (Northern Appalachia Coal): BuMines-Pressurized Combined-Cycle plant	40	0.577	2.66	0.19	0	0	H
Hypothetical Plant: Similar to #1 but with high conversion efficiency	60	14.0	80.8	130	19.7	41.1	–
Hypothetical Plant: Similar to #4 but with high efficiency	58	11.6	9.7	1.9	0	576	–

*H = Hittman.
B = Battele.

Sources: Hittman Associates, Inc. (1973) Environmental Impacts, Efficiency, and Cost of Energy Supply and End Use, Part 1 Draft Final Report.
Battelle Columbus and Pacific Northwest Laboratories, (1973), Environmental Considerations in Future Energy Growth, Vol. I: Fuel Energy Systems: Technical Summaries and Associated Environmental Burdens for the Office of Research and Development, Environmental Protection Agency.

the legislation controlling these factors.

By considering different trends in the uses of coal, oil, and gas, projections in consumption for the various fossil fuels have been made. Coal will be a minor direct source of energy by the year 2000 in the residential and transportation sectors, unless oil shortages stimulate a resurgence of steam locomotives for railroad haulage, an area in which new technology appears to have much promise. Natural gas will diminish greatly in the electrical power sector, to be replaced with nuclear power, coal and synthetic gas. Petroleum products will continue strong in the transportation sector, limited mainly by availability rather than price.

The base case forecast (continuation of existing policies with only limited change) of the Project Independence Report describes the U.S. future energy picture as follows: petroleum production is severely constrained in the short run and greatly affected by world oil prices in the long run; coal production will increase significantly but is limited by lack of markets; potential increases in natural gas production are limited but continued regulation could result in significant declines; nuclear power is expected to grow from 4.5% to 30% of total electric power generation; synthetic fuels will not play a major role from now to 1985; geothermal, solar, and other technologies will not contribute to our energy supplies before 1985.

Imports

Oil Imports. Oil imports play an important role in fulfilling the United States' demand for petroleum. Table 8-4 shows 1958 U.S. energy demand, domestic supply, and oil imports for the four cases studied in the Project Independence report.

Crude oil imports, on a four-week average for December 1974, were slightly over 4 million b/d, compared to 3.04 million b/d for a similar period in 1973. Note that, at $11 per barrel world oil price, 1985 oil imports for all four cases shown would be less than present levels. All cases show increased imports in 1985 at $7 per barrel world oil prices. However, the Project Independence study concludes that, in the next few years, oil imports will remain level or rise, no matter what long term actions we take.

In the past, the United States has received much of its imports from Western Hemisphere sources. Because of increasing domestic demand in these countries, it does not seem likely, however, that they will be able to meet future U.S. need for imports. In 1960, the Western Hemisphere was able to essentially maintain a balance in the supply and consumption of petroleum. This balance was almost achieved again in 1965.

Significant increases in imports would require expansion of U.S. port capacity. One of the key factors that will determine the changes that will be required in U.S. port facilities is the size of tankers delivering the oil. Since 1965, tanker construction has been directed almost exclusively toward vessels larger than 65,000 DWT. The development of a successful single-point mooring system that allows the unloading of deep draught tankers and the closing of the Suez Canal in mid-1967 gave impetus to the construction of Very Large Crude Carriers (VLCCs) ranging from 250,000 DWT to 425,000 DWT presently under construction. A tanker of more than 700,000 DWT has been ordered, and a 1,000,000 DWT vessel is in the preliminary planning stage. The major attraction of large tankers is the reduction in unit transportation costs that they provide.

The possible reduction in ship traffic is also obvious if larger tankers are

Table 8-4
1985 U.S. Energy Demand, Domestic Supply, and Oil Imports

	At $7 Per Barrel World Oil Price			At $11 Per Barrel World Oil Price		
	Energy Demand (quad. Btu)	Domestic Energy Supply (quad. Btu)	Oil Imports (MMB/D)	Energy Demand (quad. Btu)	Domestic Energy Supply (quad. Btu)	Oil Imports (MMB/D)
Base case with and without emergency programs	109.1	84.2	12.4*	102.9	96.3	3.3**
Accelerated supply	109.6	92.6	8.5	104.2	104.2	0
Conservation	99.2	79.6	9.8	94.2	91.8	1.2
Accelerated supply plus conservation	99.7	88.5	5.6	96.3	96.3	0

Source: Federal Energy Administration, Project Independence Report, November 1974, p. 34.
*Of these, 6.2 MMB/D would be subject to disruption.
**Of these, 1.2 MMB/D would be subject to disruption.

used. By using tankers of 100,000 DWT instead of 29,000 DWT, the number of vessels that would have to be unloaded each day for a given level of imports would be reduced to less than a third. By using a 200,000 DWT average, the number of unloadings required each day would be reduced to less than a sixth.

Because of the savings in transportation costs, the reduction in ship traffic and the lack of new small tankers, it seems inevitable that the United States will be forced to use tankers larger than 100,000 DWT. The problem is that the U.S. does not have any ports capable of handling tankers larger than 100,000 DWT.[1] The East Coast, which requires the greatest amount of imported petroleum, has only one port capable of handling a tanker larger than 55,000 DWT. The study done for the Department of Commerce's Maritime Commission shows that it is neither environmentally or economically feasible, and in some cases physically not possible, to dredge existing ports to the depth necessary to allow large tankers to enter.

Several potential alternatives for importing increased quantities of petroleum were examined in the Maritime Commission's Study. Some of these are to (1) lighten the loads of the VLCCs, offshore of existing ports, thereby reducing the drafts of the vessels sufficiently to allow them to enter the ports and complete the unloading. This procedure is presently being used to a limited extent in Delaware Bay and New York Bay; (2) develop a fleet of shallow draft large tankers that could use the present, or moderately deepened, port channels; (3) make use of conventional designs such as building a deep-draft terminal in Maine or in Lower Delaware Bay, or using single-point mooring system offshore; (4) transfer the oil to the U.S. in small tankers from deepwater terminals built in Canada and the Bahamas; and (5) make use of offshore deepwater ports, serving an entire region by a transfer system of pipelines or feeder vessels.

[1] For a detailed discussion of deepwater ports, their impacts, and alternatives (including alternative methods of importing large volumes of crude oil), see the Final Environmental Impact Statement, Deepwater Ports, Office of the Assistant Secretary – Program Development and Budget, U.S. Department of the Interior, April 1974. This statement was prepared to accompany proposed legislation authorizing the Secretary of the Interior to regulate the construction and operation of deepwater port facilities.

ENVIRONMENTAL IMPACT

The consideration of environmental impacts in this analysis primarily relates to additional ship traffic and oil handling associated with the increased level of imports.

Potential Oil Pollution. Three factors are considered in analyzing possible oil pollution related to tanker shipment of imports: (a) intentional discharge, (b) accidental discharge, and (c) casualty analysis.

Intentional Discharge. The two primary sources of intentionally discharged oil are shoreside ballast treatment facilities and underwater tank cleaning operations. Any development of ballast treatment facilities would be accomplished at the loading end of the system. It may be assumed that all intentionally discharged oil in U.S. waters from this alternative will come from tank-cleaning operations.

Accidental Discharge. In the restricted waters surrounding harbors and ports, the 1970 experience indicates that about 0.00009 precent of the oil handled is accidentally discharged (U.S. Coast Guard, 1972).

Casualty Analysis. The worldwide tanker casualty analysis indicates that an insignificant amount of total volume of oil transported is spilled, exclusive of transfer operations (USDI, 1972). The environmental impact could be nominal where small spills are involved or where the spill occurs in such a manner as to have little impact on coastal or restricted water areas. By contrast, a single catastrophic incident such as the breakup of the *Torrey Canyon* can have disastrous results. The oil spill problem is a subject involving considerable study effort. The first report of the President's Panel on Oil Spills presents considerable details relative to the subject.

To assess fully the impacts of the tank-cleaning operations, three separate analyses are necessary. While the overall average discharge rate in 1969-1970 was 0.074 percent of cargo, uncontrolled operations averaged 0.46 percent, load-on-top (LOT) averaged 0.027 percent, and the IMCO standard proposed in the 1969 amendments to the 1954 International Convention for the Prevention of Pollution of the Sea by Oil was 0.0067 percent (one part in 15,000).

Increased Tankers and Terminals. Increased petroleum imports, if available, will require an increase in the number and size of tankers. The heavily populated Northern Atlantic coastal region will be the primary destination of petroleum shipments with the Gulf Coastal region being the secondary location. If the use of conventional ports continues, tankers will generally be restricted to 60,000 DWT or less. The continued use of these small tankers will require a significant increase in the number of tankers to be unloaded each day. This added congestion would increase the risk of collision and subsequent oil pollution. The transfer of oil from VLCCs to small tankers at foreign ports would also cause substantial increase in ship traffic. The problem of port congestion could be alleviated through the use of large tankers making deliveries directly to U.S. terminals.

The environmental impacts of a terminal to handle large tankers will be determined by its location. Enlarging the channels and harbors of existing ports would require dredging that could endanger sensitive estuarine areas. These areas are important as nursing grounds for many species. Extensive dredging also presents the danger of penetrating freshwater aquifers and causing contamination of a major city's water supply. Expansion of existing port facilities in populated areas could cause conflicts with existing or planned land uses.

Offshore terminals would greatly reduce the dangers of dredging and port congestion. The determining factor would be the facilities' distance from shore. Terminals that are closer to shore will generally require a greater amount of dredging. Such a facility could, therefore, cause some danger to estuarine areas as a result of dredging and from oil spills that could reach shore before dispersing or being cleaned up. A terminal farther offshore could obviate the need for

dredging and allow spills to disperse or be cleaned up before reaching sensitive areas.

The construction of a breakwater or island will permanently eliminate from productivity the area of seafloor and volume of water it occupies. Some of this loss will, however, be offset by fish havens formed by the rubble mounds and structures. A deeper offshore setting would again be preferable because it would affect fewer species. A breakwater could reduce wave action at the shoreline and thereby reduce erosion of the beach. This could lead to the deposition of suspending sediments and accretion of the beach. Continued accretion could cause the development of a sand spit, which may ultimately extend to the offshore structure. If this accretion were located at the upper end of the beach system, the normal supply of sand would be cut off and erosion of the beach would occur. Generally, if the distance from shore is more than twice the length of the structure, the effect on the shoreline would be minimal (Maritime Commission).

Pollution Potential at Loading Site. The increased movement of petroleum will also result in increased oil spills at the loading end. These spills will, at the receiving end, result from intentional and accidental discharge and tanker casualties, such as collisions, groundings, etc. In some exporting countries, pollution control standards may not be as stringent as United States standards, and thus there may be a greater potential for pollution at some loading sites.

Natural Gas

Domestic production of natural gas will have to be supplemented in order to fulfill demand and will come in the form of synthetic gas from coal, liquid hydrocarbons, or imports. Natural gas imports could come into the United States via pipeline from Canada or Mexico or as tanker-borne liquified natural gas (LNG) from other countries, and will therefore be discussed individually in the parts that follow.

Pipeline Natural Gas Imports. Pipeline imports of natural gas into the United States have come from the two bordering countries of Canada and Mexico. In 1973, 1.0 trillion cubic feet (about 4% of U.S. gas supply) were imported via pipeline from Canada, while 1.6 billion cubic feet came from Mexico. There is little prospect for increased imports from Mexico. A relatively small proven natural gas supply base and policy of self-sufficiency in energy indicate that potential new gas will probably not be available for export. Present contracts expire in 1982; thus if no new supplies of gas are released for export, significant natural gas imports from Mexico could cease at that time (Federal Power Commission, 1972). Future increases in pipeline imports of natural gas will, therefore, have to come from Canada.

Based on actions by the Canadian National Energy Board (NEB), it appears that future increases in natural gas exports from Canada may be limited. In November, 1971, the Canadian NEB dismissed three applications for licenses to export nearly 2.7 trillion cubic feet of gas to the U.S. The NEB rejected the application because "... the Board decided that there was no surplus of gas remaining after due allowance had been made for the reasonably foreseeable requirements for use in Canada ..." (Federal Power Commission, 1972). No applications have been approved since then. Canada's intention to phase out all crude oil exports, perhaps by 1989, in order to meet their anticipated increases in domestic demand, cast further doubt on availability of Canadian natural gas.

Recent discoveries in the Arctic Islands, Mackenzie Valley, and Atlantic offshore regions may eventually result in large reserve additions. The NEB will not consider these new discoveries in its reserve calculations until they have been developed sufficiently to be within economic reach. If the discoveries continue and are developed, some gas may become available for export.

ENVIRONMENTAL IMPACT

While the construction of pipeline facilities has the potential for causing unfavorable environmental effects, the employment of good construction techniques can minimize or even eliminate most of these effects. Farming or grazing lands can usually be restored to near original condition within two or three years, by the replacement of topsoil, the replanting of grass or crops, and possibly irrigation. The esthetics of wilderness areas cannot be fully protected but the detrimental effects can be limited by using existing rights-of-way or minimizing the width of new rights-of-way, by replacing grass and shrubs on the rights-of-way, and by using such techniques as feathering and screening or deflecting entrance ways. Major displacement of wild animals will occur only during construction. Banks can and should be stabilized to avoid erosion during construction. Access and service roads must be maintained with proper cover, water bars, and appropriate slope to avoid soil erosion. Compressor stations and other aboveground facilities can be located in unobtrusive sites and where possible planted with appropriate trees and shrubs to enhance their appearance. Location, planting, and exhaust design can be used to abate excessive noise associated with operation of the compressor stations. Treatment plants can be located and equipped with devices to minimize any adverse effects upon air quality and suitable means, e.g., evaporation ponds or disposal wells, can be found for preserving the water quality of the surrounding area.

Liquefied Natural Gas (LNG) Imports. Because of the growing shortage of domestic gas supplies, plans are now being made by the gas industry for baseload LNG imports under long-term contracts. However, LNG imports cannot simply be increased to meet the demands for greater supplies of natural gas. Large-scale shipping of LNG is a relatively new industry and the United States does not yet have facilities for receiving baseload shipments. The FPC recently approved two projects that together call for deliveries of the equivalent of more than 1 billion cubic feet/day of LNG. Several other projects have been pro posed and are pending approval. In 1973, the equivalent of 3.4 billion cf of LNG was imported from Algeria and about 0.7 billion cf from Canada (preliminary data). Future import levels will, therefore, be dependent on the rate of buildup of the United States' LNG industry.

In 1971, non-Communist natural gas proved reserves were estimated to

be 1,033 Trillion Cubic Feet and production was 138 TCF. The estimate of future discoverable reserves was 6,167 TCF. It appears, therefore, that sufficient supplies of natural gas will be available for export to the United States, depending on the political situation and world pricing levels.

ENVIRONMENTAL IMPACT

Tankers. Any seagoing vessel may be involved in collision or other mishap. However, escape of LNG to the environment would not necessarily result in significant impact. Since LNG remains liquid only at -259°F at atmospheric pressure, any spilled LNG would immediately begin to vaporize, and although it would pollute the air, would have little impact on land or water resources. Studies on the possibilities of explosions resulting from LNG spills are inconclusive. Tests indicate that under certain conditions small-scale explosions result when the LNG is poured onto water. These results cannot be extrapolated to predict the result of a large-scale spill on water. Another study concluded that there was little danger of normal LNG exploding when spilled on water, and that a vapor explosion could result only after the methane content of the LNG had dropped to 40 percent. Since the normal methane content of LNG is 80 to 90 percent or more, and the boiloff rate is 0.2 percent per day, a reduction to 40 percent is not likely with present-day shipping practices. Worldwide experience to date in the handling and shipping of LNG has resulted in no serious explosion or fire. Since commercial delivery of LNG by tanker began in 1961, there have not been any accidents at sea. However, LNG spills have been reported, and they have not been serious.

Transfer and Storage. Each regasification plant will require facilities to permit the transfer of LNG from tankers to storage areas. Available methods require initial dredging and possibly continued dredging, causing increased turbidity of the water and disruption of marine animals, especially in the case of bottom-dwelling organisms. In most cases, this disruption would be temporary, but care would have to be taken to avoid commercial fishing areas as much as possible. The potential for fire or explosion is always present during the transportarion, transfer, or storage of LNG. Since spilled LNG would not vaporize instantaneously, the release of the equivalent of several million cubic feet of gas, for example, might cause a fire that could continue until all the LNG had vaporized. An early LNG plant was destroyed by a disastrous fire in 1944 because of the failure of a storage tank, with a loss of more than one hundred lives. Since then, many improvements have been made in the technology of storage and handling of the LNG, and increased attention has been given to proper safety precautions. However, the recent explosion of a Staten Island storage tank, killing more than 40 men, shows that there is still an element of danger involved in the storing and handling of LNG.

Regasification. The construction of regasification plants will have an impact on land resources. The extent and duration of the impact will depend on the size and location of the plant. For example, the plant proposed for Cove Point, Md., would produce initially 650 million cubic feet per day and require a 1,022-acre tract of land. Another plant proposed for Savannah, Ga., would produce initially 335 million cubic feet per day and require 860 acres. These figures result in ratios of 1.5 to 2.5 acres per mmcf capacity, respectively. During construction, there will be some disruption of the land surrounding the plant and some damage to animal habitats. This damage will be permanent only in the area occupied by the plant and supporting facilities.

Since natural gas or water will be used to regasify the LNG, very few pollutants will be released to air or water. Plants using water to regasify LNG will release the water at a lowered temperature. In the case of the Savannah Plant, water temperature will be lowered 5°F before being returned to the river.

A regasification plant could have an impact on the scenic and recreational resources of an area. The choice of the plant site is an important factor in minimizing the impact on scenic qualities and recreational activities. The increase in ship traffic could have an effect on water-oriented recreational activities.

Impact of Combustion and Transportation. Since natural gas is a relatively clean burning fossil fuel, the impact on air quality would not be significant. LNG imports will require the construction of new pipelines. The impact of this construction has been discussed earlier in relation to domestic production of natural gas.

Outer Continental Shelf (OCS) Production

This alternative would require increased exploration, development, and production of crude oil from offshore areas. Supplies equal to all or a significant part of any reduction in Federal coal production would have to be developed and produced in addition to those supplies that are projected to be produced from OCS resources under the present leasing schedule during the same time period.

Even though there is a demonstrated need for development of petroleum resources in offshore areas, development has not progressed to the extent required to meet projected production requirements. In order to further the goals of domestic energy self-sufficiency, the President called for an acceleration of OCS leasing. In November 1974, the Bureau of Land Management released a proposed OCS planning schedule which indicates 24 possible sales from 1975 through 1978. Nine sales are listed for Alaska, six for the Atlantic coast, five for the Pacific coast, and four for the Gulf of Mexico. Six of the sales involve water deeper than 200 meters. The schedule is intended for planning purposes and all sales listed in it are subject to modification or elimination. Lease sales in the Atlantic and Cook Inlet, Alaska, depend on resolution of litigation between the U.S. and the States.

The move into frontier areas and deeper waters will impose greater capital needs and consequent need for more rapid payouts than the usual 12 to 16 years now in effect in the Gulf of Mexico. It is estimated that the move from depths less than 200 m to 300 m depths of water may increase exploration costs two times and development drilling two and one-half to three times. It becomes evident, then,

why the fields in deep water must be very large to be economically exploitable.

As operations move to deeper waters and more hazardous physical environment, equipment and data needs will increase. For specific areas, more detailed wave-height, wind-force, and storm information will be needed.

Changes that could be beneficial to stimulation of additional development include price increases, subsidies, tax benefits, and changes in leasing procedures. The cost and effectiveness of such changes are unknown The timeliness and the volume of increased supplies that would result from increased incentives are also unknown. Drilling rig availability might be a major problem About 72 mobile drilling rigs were operating in domestic offshore waters in November, 1974.

Great acceleration of OCS leasing is one of the key elements in the accelerated supply strategy outlined by the Project Independence Report.

ENVIRONMENTAL IMPACT[1]

Development and production on the OCS will result in a variety of impacts on the natural environment, on other resource uses, on air and water quality on land-use patterns, on the social order, and on the economy. Some impacts are the unavoidable result of routine operations, while others are caused by occasional human error. Still other impacts are avoidable and can be controlled or avoided by safe operating practices and by regulations.

Impact on Biota of the Open Sea. Except for the impact resulting from pipeline laying across the beach and through the coastal wetlands, most impacts resulting from OCS leasing affect the plants and animals of the open sea. Such impacts result from accidental loss of debris, discharge of drill cuttings, sand, drilling fluids, the burial of pipelines, and the accidental spillage of oil or other toxic materials.

Impact on Pelagic Marine Life. Pelagic marine life includes a broad spectrum of organisms from all trophic levels and includes the phytoplankton, zooplankton nekton (euphausids, shrimp, fish, squid, and marine mammals), and pelagic seabirds.

After an oil spill has occurred, oil which has not evaporated, been carried ashore, or cleaned up will be dispersed as minute droplets in the water and may damage marine organisms and enter the marine food chain Little information has been found concerning the effect of large spills of crude oil on the zooplankton.

Small spills of fractions of a barrel to 50 barrels probably occur on the order of a thousand times per year in the Gulf of Mexico. A long-term effect of low-level pollution are unknown. However, since hydrocarbons are taken up into the food chain and can become concentrated in marine species used by man for food these potential effects are of great importance. The change of opinions on this question among scientists goes from deep pessimism to cautious optimism.

The regular discharge of formation water, or "brines," could have a severe, but extremely localized, impact on plankton. Although only traces of entrained oil remain formation waters contain a heavy concentration of dissolved salts and are devoid of dissolved oxygen.

Physiological stress would probably result from an osmotic imbalance (cells losing water to surrounding brine), and low dissolved oxygen would lead to suffocation.

The remaining impacts on plankton will also be extremely localized and are all related to increased turbidity caused by the discharge of drilling fluids and drill cuttings and the jetting of sediments during underwater pipeline burial. The effect of this turbidity on a given parcel of water usually lasts a few hours at the most. Turbidity curtails the penetration of sunlight, and therefore, depresses synthesis by phytoplankton.

Nekton include all marine animals that are active swimmers and are able to migrate freely over considerable distances. This mobility, combined with their ability to sense irritation and with their natural escape and avoidance behavior, enables them to flee localized adverse conditions.

Therefore, the only significant impact that nekton could suffer would result from a massive oil spill. However, for nekton other than fish, these impacts are largely unknown.

In the past, the injury and death of thousands of seabirds has been the obvious impact of massive oil spills. The insulating properties of oil-clogged plumage are greatly reduced, resulting in heat loss. Ingestion of oil can cause a variety of pathological conditions. Feeding may drop, causing fat reserves to be exhausted. Indirect impacts could include loss of habitat and nesting areas because of installation of onshore facilities.

Impact on Benthic Marine Life. Environmental impacts that may be expected to affect benthic life adversely will result from the discharge of drill cuttings, accidental spillage of oil (and associated use of emulsifiers) and other toxic materials, and the burial of newly constructed pipelines.

Spilled oil that has not evaporated or been cleaned up or has been stranded on a beach after being dispersed into the water as droplets, adheres to particulate matter and sinks to the bottom where it comes into direct contact with the benthos. Studies of the effects of oil on benthos have yielded only tentative and qualified conclusions.

During entrenchment of new pipelines, most, if not all, benthic fauna are either destroyed by the jetting or raised into the surrounding water and rendered completely vulnerable to predation. Although recolonization would begin immediately, the native fauna could not be fully restored until seasonal reproduction cycles had been completed by representative species from adjacent areas, which would provide a supply of larvae to settle and enter the reworked substrate.

Turbidity resulting from resuspended sediment could have an adverse impact on filter-feeding apparatus by blocking respiratory surfaces. Another possible source of impact is the resuspension of toxic heavy metals by a polluted stream or runoff. The possibility exists that these toxic materials could be ingested by lower marine life and could then be magnified through the food chain until they accumulated in serious quantities

[1] For a detailed discussion of environmental impacts of OCS development, see the Final Environmental Statement – OCS Sale No. 37 (FES 74-82), Bureau of Land Management, U.S. Department of the Interior, 1972.

in top carnivores, including species harvested for human food.

Impact on Beach and Associated Biota. Impacts on the beach and associated biota could result from contamination by spilled oil and from disruption in the path of pipeline burial excavations. Studies of sandy beaches have generally been inconclusive. Pollution studies of rocky shorelines, with their characteristic assemblages of seaweed, barnacles, limpits, anemones, have concluded that, where organisms have been covered by crude oil and Bunker C fuel oil, death is primarily blamed on smothering due to the physical coating. When the pollutant has been a lighter refined oil (No. 2 fuel oil, diesel fuel), death and stress has been associated primarily with toxic effects of the oil. It is also possible that shorebirds could also become coated with oil. The results would be the same as for pelagic seabirds.

Burrowing animals and rooted plants in the path of pipeline laying operations will be killed or damaged. At least one growing season would be required for the impact to be abated.

Impacts on Embayments, Channels, Water Courses, and Associated Biota. Living organisms in estaurine and inland waters could be adversely affected by spilled oil and by dredging activity during the burial of new pipelines. Oil pollution in the semi-enclosed waters of a bay system could be more serious than in the sea or along the open coastline because the pollutant would be, relatively speaking, entrapped, with tidal flusing being its only source of removal. Many species undergoing early development in estaurine waters are vulnerable to even small quantities of toxic compounds containing oil.

Impact on Wetlands. The wetlands include the mudflats, sand flats, coastal marshes, and bay and barrier island fringing marshes. Dominant vegetation consists of the spartina type of grasses and algae. Insects, worms, and protozoa are the dominant fauna. Large populations of waterfowl and wading birds are found also.

Three types of adverse impacts are possible in the wetlands environment: pollution by spilled oil, disturbance during pipeline construction, and loss of habitat from lands taken for installation of onshore pipeline transfer terminals and gas treating facilities.

Pipeline burial in the marshes may have physical destruction of vegetation and immobile fauna in the path. The impact on a narrow band of marsh in the path of the pipeline operation will probably be severe, but of short duration. In addition, new pipelines will probably result in the construction of onshore pipeline terminals or gas treatment facilities. The resulting impact will be the removal of a small amount of marsh habitat (on the order of 5 acres or less per facility).

Impact on Air Quality. The quality of air over the leasing area could be degraded by exhaust emissions of stationary power units and service vessels and by accidental release of oil and gas from wild wells.

If a wild gas well were not burning, methane, ethane carbon dioxide, and nitrogen would be released into the air. If the gas well were on fire, combustion would be essentially complete and the emissions would consist almost entirely of carbon dioxide (CO_2) and water; the nitrogen would remain as N_2 and any sulfurous gases would be oxidized to SO_2. The resulting impact would not be great.

If a wild oil well were releasing crude oil onto the water, the resulting impact would be substantially greater. If the oil does not burn, a significant amount of it will evaporate. A reasonable estimate of the range of emissions, assuming complete combustion, that an oil well fire could produce per 1,000 bbl burned is 340,000 to 347,000 lb of CO_2, 620 to 34,000 lb of SO_2, and 660 to 10 000 lb of NO. As a point of reference, during the Chevron 1970 fire and spill, the maximum spillage rate was estimated to be 1,000 bbl per day

However, combustion of oil would in reality be incomplete, and emissions would contain a somewhat smaller amount of the above compounds, but would include, in addition, such materials as volatilized petroleum, particulate carbon carbon monixide, nitrous oxide, sulphur monoxide, and other altered or partially oxidized matter.

Impact on Water Quality. Debris and bilge will be released into waters from the many seismic vessels, crew boats, tugs, and service and supply boats used throughout the operation.

During the drilling operations, drilling fluids and drill cuttings will be discharged into the sea. Most drill cuttings consist of sand and shales and therefore caused no turbidity, but settle to the bottom in minutes. The chemicals used in drilling muds have a relatively low level of toxicity and produce a plume of turbidity in the water near the surface when discharged. The visible plume is on the order of a few feet wide and a few yards long.

The production and discharge of formation waters (oil-field brines) is also a potential source of pollution. Formation waters contribute to water quality degradation when released into the sea because of their small amount of entrained liquid hydrocarbons, their high concentration of dissolved mineral salts, and the absence of dissolved oxygen.

Water quality could be further degraded as the result of accidental oil spills. Part of this spilled oil would be removed by cleanup operations and some would evaporate, but the largest proportion would probably be dispersed into the water.

Another source of water quality degradation is the resuspension of sediment during pipeline construction and burial. The duration appears to be on the order of several hours at a given location.

Impact on Commercial Fisheries. The general consensus of Gulf fishermen is that underwater stubs present the greatest problem. The presence of offshore structures is a moderate inconvenience, and the debris problem is minimal.

Removal of Sea Floor From Use by Trawlers. All shrimp and industrial bottom fish are caught by dragging a large trawl across the sea floor. Every site occupied by a drilling or production platform and its attendant service boats and barges must be avoided by trawlers. If the structure is a jack-up drilling rig or permanent production platform, the area of sea floor removed would be 2 to 5 acres. In deeper waters (over 300 ft), a semisubmersible drilling rig with its anchoring system would occupy up to

325 acres (assuming a 1,500 ft anchoring radius). The duration of exploratory drilling ranges from under 45 days for a single well to around 6 months for multiple well explorations. Permanent production platforms may remain in place for 10 to over 20 years. The probability that permanent platforms will be erected on each tract, based on past exploration success rates, is about 35 percent. It is estimated that each full tract (5,760 or 5,000 acres) developed will average three structures.

Creation of Obstructions on the Sea Floor that Cause Damage to Trawling Nets. Obstructions that may interfere with trawling are underwater stubs, large pieces of debris, and unburied pipelines. Although Coast Guard regulations require that stubs be marked by a buoy at the surface, if located in 80 ft or less of water, these buoys are frequently found to be missing. If a trawler pulls his net across a stub, it will certainly be badly damaged or lost. Large pieces of debris, such as equipment, piping, structural members, tools, and the like, if accidently lost off a platform, service boat or barge, may damage trawling nets of fishermen unlucky enough to snag them.

It has also been reported that unburied pipelines (beyond the 200-ft depth contour) pose a serious problem to the shrimp trawling operations in the Gulf of Mexico (Farrelly, 1972). A significant amount of shrimp trawling does occur in water depths where pipelines remain unburied.

Contamination of Fish by Spilled Oil. Fish that are either externally coated or internally contaminated with oil are unmarketable. It has been shown that fish that live in the vicinity of chronic spillage are likely to be internally contaminated. Oyster beds have been contaminated in the past from oil spilled in the marshes, bayous, and bays in the delta region of Louisiana, but we are unaware whether contaminated catches have ever been taken in the open waters of the Gulf.

Conflict with Ship Traffic and Navigation. Despite the existence of fairways in some areas, the possibility of a collision with drilling rigs, permanent platforms, and their attendant vessels remains. Detrimental results would include loss of human life, a spill of oil, release of debris including part of or the entire drilling rigs, and the ship and its contents, if it sinks. Floating trash accidentally lost off platforms is a hazard to boats.

Impact on Recreation, Sport Fishing, and Esthetic Values. Pipeline construction and burial disturbs a small area of beach (about 30 ft wide). The first high tides following burrial of the pipeline will restore the beach terrain. The restoration of the beach region will take longer, most likely requiring a storm tide or high winds to obliterate the effects of the excavation.

An oil spill would directly affect water sports, and would detract from enjoyment of other beach-oriented recreation.

Sport fishing would be curtailed in the vicinity and for the duration of any spill incident. However, extensive testimony and evidence indicated that oil and gas operations have an overall favorable impact on sport fishing activities. Sport fish congregate near offshore platforms, which serve as artificial reefs. In the open sea, offshore platforms provide both food and cover in areas that are largely devoid of those essentials. Myriad forms of microorganisms in the water drift by these structures and attach themselves, soon encrusting all exposed surfaces on the platform.

Adverse esthetic impacts result from floating debris or oil washed into bays or onto beaches, temporary scars from pipeline burial, and visibility of some nearer offshore structures from the shore.

Impact on Land Use and Land-Use Trends. Pipeline laying and the construction of pipeline terminal facilities temporarily disrupt a snall amount of land. Since pipelines onshore are buried, there would be no permanent loss of the land for grazing, farming, etc.

Exploration and production in new offshore areas could require a marginal influx of labor and redistribution of population due to the absence of a large petroleum-based industry and a labor force with the necessary skills.

For an account of various studies on the impacts of oil spills and oil and gas operations offshore refer to any recent environmental statement for offshore lease sales, issued by the Bureau of Land Management, U.S. Department of the Interior.

Oil Shale[1]

Large areas of the United States are known to contain oil shale deposits, but those in the States of Colorado, Utah, and Wyoming are of greatest potential for commercial shale-oil production. It is estimated that some 73 percent of the oil shale lands containing nearly 80 percent of the shale oil are public lands. The highest grade deposits occur over an area of 17,000 square miles (11 million acres), and contain an estimated 600 billion barrels of oil. Recovery of even a small fraction of this resource would provide significant amounts of energy adequate to supplement the Nation's oil supply for many decades.

Three reporting processes have been developed to the point of technological practicability but none have been demonstrated and tested at a commercial production scale. The mining of the shale presents no particularly difficult technological problems as it can be done by conventional room-and-pillar underground mining or by surface mining techniques. The major barriers to development of this alternative are the need for full-scale demonstration and testing of these processes and developing necessary cost and other data for determining economic feasibility

On June 20, 1971, the Secretary of the Interior announced plans for a proposed prototype oil shale leasing program to make available to private enterprise, for development under lease, a limited amount of public oil shale resources. Leases were issued by competitive bonus bidding and included royalty obligations to the United States. Of the six tracts offered, four were leased.

In the final environmental statement for this program (Volume I, p. III-6, 1973), "The Department of the Interior estimates the maximum 1985

[1] For a detailed discussion of oil shale technology and impacts, see the Final Environmental Statement for the Prototype Oil Shale Leasing Program, U.S. Department of the Interior, 1973.

production from oil shale to be one million barrels per day Even at this rate of production, only about 9% of the 80 billion barrels of prime commercial interest would be produced by the year 2000. The ultimate size of the oil shale industry will most likely not be determined by the magnitude of the oil shale resource but will probably be limited by other factors, such as the availability of water."

However, since economics and technology are still uncertain and in the early stages, the development of oil shale will likely be more severely affected by soaring costs and the general uncertainty in the energy situation.

ENVIRONMENTAL IMPACT

Impact on Land Quality. The development of an oil shale industry would require roads, mining, plant sites, waste disposal areas, utility and pipeline corridors, and associated services during the productive life of a lease. These activities would change the existing pattern of land use, alter the existing topography, and affect natural vegetative cover until revegetation operations began. Restoration of surfaces to suitable conditions compatible with pre-existing uses would be required before site abandonment.

Processed shale could be deposited in canyons and gullies, which would gradually be converted into flatter areas. Contouring and revegetation would probably reduce erosion. However, the spent shale is larger in volume than the shale when removed from the mine, and revegetation will be retarded by the arid climate.

Where areas to be developed are now used for livestock grazing, agriculture, wildlife habitat, or recreation, some unavoidable changes in land-use patterns would result.

Impact on Water Quality. One of the greatest possible impacts would be the requirement of large amounts of water for retort plants and the disposal of waste water. Approximately 150,000 acre-feet annually would be required for one million barrels per day of shale oil production.

'In addition, as much as 10 gallons of water per ton of shale could be produced in the surface retorts. This water could contain dissolved saline and organic compounds. It could be used to moisten the waste shale to prevent dust problems. However, it would require treatment prior to other uses to remove hydrocarbons, malodorous compounds, and, perhaps, dissolved minerals.

Large quantities of natural groundwater occur in leached zones of the deep oil shale areas, but the location, composition, and movement of such waters have yet to be defined in many areas. These aquifers may contribute substantially to the overall water supply available to satisfy requirements for oil shale development. Other sources are the Colorado River and its tributaries in Colorado. In Utah, potential sources for development of oil shale in the Uinta Basin are the Green White and Yampa Rivers. In Wyoming, the Green River is the principal surface water resource of the Green River Basin. To insure dependable supplies from these rivers might require construction of dams and reservoirs or purchase of water from existing reservoirs.

Use of groundwater in oil shale development could decrease the natural discharge of springs and seeps. Without proper care, degradation of water quality could occur from discharge of product or waste waters, siltation of streams, or leaching of saline minerals from spent shale.

Impact on Air Quality. Impacts on air quality could arise from particulates, sulfur and nitrogen oxides, and dusts produced in mining and shale disposal. The immediate down wind air quality consequences depend largely on the process and the amount of pollutants emitted, height of the stack (if any), surrounding terrain, and geographic location. Solid particulates in gaseous discharges to the atmosphere would be small, but unavoidable, at the present state of technology. New central techniques now being developed for other industrial operations could be incorporated into this industry. Some local problems with temperature inversion may be experienced, the significance of which cannot now be established. The long-term effect of industrialization would result in a decline in general air quality of the region.

The local noise level near developed sites is expected to increase, due to mining, retorting, and other processing operations. This is an unavoidable adverse consequence of increased industrial activity in a region that is now predominantly a semiwilderness and can be only partially mitigated by noise abatement devices.

Impact on Fish and Wildlife. Noise and associated human activities accompanying construction and operation would have a new effect of stress and disturbance on normal behavior and activity patterns of wildlife. Species that could be affected by such disturbances include mountain lion, bear, elk, mule deer, antelope, bobcats, sage grouse, blue grouse, and migratory birds. Encroachment of humans causes loss of habitat, and often adjacent areas cannot support the displaced animals.

Airstrips and increases in air traffic would provide some source of aerial harassment of mule deer, wild horses, and big game.

Wildlife food and cover values of lands used for mining, pipeline and road construction, building, etc., would be at least temporarily lost. Such habitat loss would in turn result in lower populations of animals.

Oil shale related drying of surface water features, such as springs, seeps, and small streams, would change the natural plant and animal complex associated with each particular water feature, including the related distribution of game, wild horses, and cattle.

Coverage of roadside vegetation with vehicle-caused dust would constitute a minor, but chronic problem, since such vegetation would lose its wildlife food value until washed off by subsequent rains.

Unpredicted or uncontrollable changes in the quality of local surface or groundwater would result in accompanying impacts on aquatic fish and wildlife populations and their habitats. Sediment, leached substances, saline groundwaters, and toxic materials, if released to surface waters, and could lower biological productivity and impair fish spawning and nursery areas.

Some small losses of oil would occur in handling, storage, and transmission. Spilled oil could damage or

kill trees, shrubs, other vegetation, birds, some species of both land and water mammals, and fish and other aquatic organisms.

Urbanization related to oil shale would also create stress on regional wildlife populations. Reductions in surface water quality near population centers as a result of sewage, toxic substances, and siltation would adversely affect aquatic organisms and their habitat. Some wildlife would be displaced by buildings, roads, parking lots, etc. Additional wind and water erosion would occur. Increased ground vehicle traffic would result in more frequent road kills of deer and other game.

Increased hunting pressure would cause localized adverse impacts upon wildlife through reduction of populations of some species, including a few already scarce species such as the brown bear and cougar. Semiremote hunting and fishing qualities would be lost.

ONSHORE OIL AND GAS

Crude Oil[1]

U.S. crude oil production peaked in 1970 and reserves have fallen each year since 1966. Drilling effort has only recently reversed its long-term downward trend. Only the discovery of the Prudhoe Bay field in the Alaskan North Slope was an exception to this trend.

Future supplies of oil will be determined by four fundamental factors:

- The amount of oil remaining to be found;
- The success in finding the remaining supply;
- The ability to recover (produce) what is found;
- Costs of the necessary exploration and production efforts.

The Project Independence Report estimated crude oil production possibilities under two cases, business-as-usual (BAU) and accelerated development (AD), and for each case, under varying prices. The primary findings of the study are:

1. Because of the long lead times required to bring new petroleum fields into production, domestic production of crude and natural gas liquids (NGL) will continue to decline for the next few years, regardless of higher prices or policies designed to encourage exploration. At minimum acceptable prices[2] of $4 a barrel or less, production could continue to decline throughout the forecast period, even with new production from the OCS and Alaska. Even the development of NPR 1 (Elk Hills) and extensive OCS leasing could increase production by only about one million barrels.

   Under both BAU and AD assumptions, minimum acceptable prices of $7 or higher would reverse the downward production trend. At $7 and $11 a barrel, respectively, production under the BAU scenario, would increase to 11.1-12.2 million barrels a day by 1980, and to 11.9-15.0 million barrels a day by 1985, exceeding the all-time high production of 11.3 million barrels a day reached in 1970. Table 8-5 shows crude oil and natural gas liquids estimates.
2. At $11 per barrel oil, domestic onshore production would increase slightly under both BAU and AD assumptions. Almost half of the onshore production would be from new secondary and tertiary recovery, while conventional and new primary fields would decline considerably from 1974 levels.

The major new source of oil in these projections is Alaska. Under BAU assumptions, Alaska would provide 3 million barrels per day, mainly from the North Slope fields. If development of the Naval Petroleum Reserves is allowed, an additional 2 million barrels per day would be produced. The increased development in Alaska will shift the focus of United States oil production: Alaska could produce 20-25 percent of our oil by 1985, although it now accounts for less than 2 percent.

The 1985 projections also indicate substantial increases in lower 40 OCS production. Although production could increase about 1.2 million barrels per day under BAU assumptions (two-thirds of the increase from the Gulf of Mexico), OCS production could reach 4.3 million barrels per day (300 percent increase) under AD conditions. The major sources of this increase would be the offshore California and Atlantic fields. Considerable opposition to leasing of these areas could be expected (see Table 8-6 for

Table 8-5
Summation of Unconstrained Regional Production Possibilities for Crude Oil and Natural Gas Liquids
(Million barrels per day)

Minimum Acceptable Price per Barrel	1974	1977	1980	1985
	Business-As-Usual			
$ 4	10.5	9.0	9.8	9.8
7	10.5	9.5	11.1	11.9
11	10.5	9.9	12.2	15.0
	Accelerated Development			
$ 4	10.5	9.7	11.1	11.6
7	10.5	10.2	12.9	16.9
11	10.5	10.3	13.5	20.0

[1] This discussion is taken from: Federal Energy Administration, Project Independence Report, November 1974.

[2] Defined as exploration and production costs plus royalty and 10 percent after tax discounted cash flow from investment, but excluding lease acquisition cost and rental. These rents were evaluated after market clearing prices were determined

Table 8-6
Potential Rates of Domestic Oil Production
(Millions of barrels per day, at $11 oil)

Production Area	1974	BAU 1985	AD 1985
Onshore – Lower 48 States	8.9	9.1	9.9
*Conventional fields and new primary fields	6.9	3.4	3.5
*New secondary	–	2.4	2.4
*New tertiary	–	1.8	2.3
*Natural gas liquids	2.0	1.5	1.6
*Naval Petroleum Reserve #1	–	–	0.2
Alaska	0.2	3.0	5.3
*North Slope	–	2.5	2.5
*Southern Alaska (including OCS)	0.2	0.5	0.8
*Naval Petroleum Reserve #4	–	–	2.0
Lower 48 Outer Continental Shelf	1.4	2.6	4.3
*Gulf of Mexico	1.3	2.1	2.5
*California OCS	0.1	0.5	1.3
*Atlantic OCS	–	–	0.5
Heavy Crude Oil and Tar Sands	–	0.3	0.5
Total Potential Production	10.5	15.0	20.0

a detailed description of potential production levels).

3. If production increases to 15-20 million barrels per day by 1985, this level of production could not be maintained indefinitely at these prices, as oil reserves at these prices would soon peak Thus, in addition to potential constraints toward achieving these levels of production, the non-renewable nature of these resources should be considered.
4. At a minimum acceptable price of $7 a barrel, under the BAU scenario, almost 40 million barrels of petroleum liquids would be produced from 1974 to 1985. This is almost equal to the 48 billion barrels of proved and indicated additional reserves of oil and natural gas liquids reported at the end of 1973 by the American Petroleum Institute. However, under AD conditions and at a price of $11 a barrel, cumulative production between 1974 and 1985 would be over 50 billion barrels. These production figures imply that huge additions to reserves would be needed in this time period. These additional reserves would about equal the most conservative estimates of undiscovered recoverable oil in the United States, although they would still be less than NPC estimates.

The uncertainties inherent in estimating future petroleum production (especially uncertainties having to do with the magnitude of undiscovered resources in as yet totally unexplored provinces and the finding rate per foot of exploratory drilling) are so great that numerical estimates of this type are highly speculative.

Sensitivity analyses show that, within a range of reasonable assumptions, different values regarding discount rates, financial costs, and finding rates could affect the quantities produced at $4, $7 and $11 per barrel in 1985 by 10 to 40 percent. Other assumptions about drilling costs, effective depletion rates, and co-product prices would affect production levels at these prices by as much as 15 percent.

Uncertainties regarding many of the factors used in the oil production model will be resolved only as additional exploration is undertaken. This is especially important in areas of high drilling and production costs, such as northern Alaska and deeper parts of the OCS, where even at high prices only giant fields might be economically feasible. Other uncertainties can be reduced through stabilized government policies affecting petroleum exploration and development.

Natural Gas[1]

Total proved reserves of natural gas in the U.S. reached a peak of 293 trillion cubic feet at the end of 1967. Until that time, natural gas reserve additions had exeeeded production each year. However, in 1968 production exceeded reserve additions and this situation has continued except for 1970 when Alaska's Prudhoe Bay field reserves were added to the inventory. In the lower 48 states production has exceeded reserve additions in each of the past six years. During this period reserve additions in the contiguous states have averaged only 9.5 trillion cubic feet annually compared to annual average production of 21.4 trillion cubic feet. This imbalance between reserve additions and production has resulted in a sharp decline in proved reserves since 1967 and has accelerated the decline in the

[1] This discussion is taken from: Federal Energy Administration, Project Independence Blueprint, Final Task Force Report, Natural Gas, November 1974.

reserve to production (R/P) ratio. The R/P ratio which was 32.5 at the end of 1946 had declined to 11.1 and 9.7 by the end of 1973 for the total U.S. and the lower 48 states, respectively. Proved reserves with and without Alaska were 250 and 218 trillion cubic feet at the end of 1973.

Maintenance of our current level of production would require annual additions to our proved reserve inventory of approximately 22.5 trillion cubic feet. This will be a formidable task because, since 1946, average annual additions in the lower 48 states have been slightly less than 16 trillion cubic feet. With Alaska included, average annual additions have been approximately 17 trillion cubic feet.

Annual natural gas production has increased steadily from less than one trillion cubic feet in 1918 to over 22 trillion cubic feet in 1973. Annual increases were only nominal through 1954 with the major portion of the increase in production coming after that time. Since 1970 the annual production increases have become progressively smaller and production in 1973 increased less than one-half of one percent over 1972. This is probably indicative that our currently proved gas reserves in the lower 48 states are producing at or near capacity. Natural gas production in Alaska, which has been restricted due to the lack of market outlets, amounted to slightly more than 130 billion cubic feet in 1973, of which nearly one-half was exported to Japan as LNG.

For the short-term, the maintenance or increase of our current level of gas production will, in all likelihood, hinge on the development of additional onshore supplies, where there is little lag time between drilling and production.

Potential gas resource estimates consist primarily of the undiscovered portion of the natural gas resource base. There have been many estimates made in the past of our potential gas resources. These estimates, which have been based on a wide variety of assumptions and methodologies, differ considerably in magnitude. In general, the potential estimates are concerned with gas that will be found and produced in the future under certain assumptions with regard to price and technology.

Two of the most often quoted potential gas resource estimates are those prepared by the Potential Gas Committee (PGC) and the U.S. Geological Survey (USGS). As defined by the Potential Gas Committee, potential supply is gas that will be found and proved by test wells. These wells may be drilled in the future under the assumed conditions of adequate but reasonable prices, and normal improvement in technology. The PGC, which makes biennial estimates of our potential gas supplies, divides its estimate into three categories of decreasing reliance: probable, possible, and speculative supplies. Probable supply is associated with existing fields, and includes both discovered and undiscovered reserves. Possible supply is in undiscovered fields in areas of established production, and speculative supply is in untested territories or formations where no production is present, and the estimates are based on a minimum amount of information.

The USGC recently revised its estimates of potential gas supplies and adopted new definitions for mineral reserves and resources. Although the USGC terminology is different from that used by the PGC because it is used for all minerals and not exclusively for gas, general comparisons can be made. The USGC classification of indicated and inferred reserves is basically the same as the probable supply category used by the PGC. The USGS definitions for these two categories follow:

"*Indicated Reserves:* Reserves based partly upon specific measurements, samples, or production data, and partly from projection for a reasonable distance on geological evidence."

"*Inferred Reserves:* Those reserves based upon broad geologic knowledge for which quantitative measurements are not available. Such reserves are those estimated to be recoverable in the future as a result of extensions, revisions of estimates, and deeper drilling in known fields."

The USGS classification of undiscovered recoverable resources, which includes "hypothetical and speculative" resources, is similar to the possible and speculative supply categories used by the PGC. The USGS definition is as follows:

"*Undiscovered Recoverable Resources:* Those quantities that may be reasonably expected to exist in favorable geologic settings, but which have not yet been identified by drilling. Exploration will permit the reclassification of such resources to the reserve category."

There is a high degree of uncertainty involved in trying to estimate the magnitude of undiscovered resources. This is especially true of oil and gas where wells must be drilled to determine if an area contains commercially recoverable hydrocarbons. This is certainly true of our Atlantic Offshore area where no wells have been drilled to date. The following table includes a comparison of the PGC and USGS estimates.

It can be seen from Table 8-6 that our potential gas resources based on the PGC and USGS estimates range from about 1,100 to over 2,200 trillion cubic feet. This compares to our current proved reserve supply of 250 trillion cubic feet and our total discovered gas supply, through the end of 1973, of slightly over 700 trillion cubic feet. Total discoveries of 700 trillion cubic feet since the beginning of the industry in this country over 100 years ago are indicative of the effort that will be required to convert our potential gas resources (as estimated by PGC and the USGS) into commercially producible reserves.

ENVIRONMENTAL IMPACT

Air quality impacts stem principally from the emission of particulates.

Air quality in immediate areas of development will be reduced somewhat, usually temporarily, because of removal of ground cover, vehicle traffic, and occasional equipment failure or blowouts.

Vapor venting from storage tanks and vessels and the burning of waste petroleum and chemical products, especially those containing some sulfur compounds, could result in increase of particulates and objectionable odors.

It is highly unlikely that air quality reductions from petroleum operations would significantly alter conditions affecting the growth of flora.

Table 8-7
Comparison of Potential Gas Resource Estimates
(Trillion Cubic Feet)

Area	Probable		Undiscovered		Total	
	PGC	USGS	PGC	USGS	PGC	USGS
Lower 48 States Onshore	154	93-177	396	500-1000	550	593-1177
Lower 48 States Offshore	58	22-43	172	225-450	230	247-493
Atlantic[1]	–	–	35	55-110	35	55-110
Gulf of Mexico	57	21-41	127	160-320	184	181-361
Pacific	1	1-2	10	10-20	11	11-22
Total Lower 48 States	212	115-220	568	725-1450	780	840-1670
Alaska	54	15-30	312	275-550	366	290-580
Total United States	266	130-250	880	1000-2000	1146	1130-2250

[1]The potential of Florida's Atlantic Continental Shelf is included with the Gulf of Mexico in the PGC estimate.
Sources: PGC estimate; "Potential Supply of Natural Gas in the United States, as of December 31, 1972," November, 1973.
USGS estimate: "USGS Releases Revised U.S. Oil and Gas Resource Estimates," Department of Interior News Release, March 26, 1974.

The modification of landform necessary for petroleum production results in varying degrees of environmental impacts on the physical and chemical land characteristics, biological conditions, cultural factors, and ecological relationships.

Depending upon the terrain and local conditions, access to the land is normally from existing road networks, extensions of these roads, and expansion of trails. For initial exploratory work, minimum alterations are made in roadway systems. After decisions are made to drill in a given area, an improved road system is required for the transportation of heavy loads. The drilling site must be cleared of vegetation that might present obstacles. Once production has been established, newly constructed roads are normally upgraded. Environmental impact results from removal of topsoil and surface vegetation to establish right-of-way corridors and location sites and alteration of drainage patterns and watershed cover during these road-building and maintenance operations.

In the construction of roadways, surface vegetation is removed and drainage patterns are modified. As a result, erosion and siltation occur, resulting in changes in landform and modification of drainage patterns, which affect wildlife and vegetation.

Land use and recreation activities may also be disrupted. Scenic views and vistas, wilderness qualities, and physical features are altered, at times permanently. Population density, employment, and cultural lifestyles would undergo long-term changes which affect access, utility networks, waste disposal, and creation of additional corridors.

Perhaps the worst environmental impact from oil and gas operations results from oil, chemicals, brine, or waste material pollution released from spills, leaks, blowouts, human errors, or equipment failure.

Land pollution, primarily from salt water and accidental oil spills, can result in soil sterilization that could be of a long-term nature and affect not only the topsoil but also underground water quality. Native vegetation and crops can be adversely affected for both the short and long term, depending upon the volume and toxicity of the pollutant, resistance of the flora, and the techniques and technology employed. Alterations of the flora in turn affect the habitat of birds and animals. Depending on the degree of pollution, land uses such as agriculture, grazing, forestry, and wilderness can be altered for varying periods of time. In some cases, large pollutant concentration could be sufficient to kill vegetation, trees, or crops and disrupt wilderness areas for long times. Recreation in areas subjected to large pollutant concentrations can also be altered for long periods of time.

In exploring and laying pipe, any spills that occur normally would be small. Major spills could occur in drilling, production, and in the movement of petroleum liquids by marine transportation. The principal cause of liquid pipeline accidents has been corrosion in older pipelines. Fewer accidents would be expected in new lines.

Large amounts of saltwater may accompany oil production as oil fields age. Such water can create pollution problems from producing wells on land or freshwater-covered areas. According to a study of the Interstate Oil Compact Commission (IOCC), up to 25 million barrels of saltwater are produced daily from the Nation's oil wells.

Proper disposal of produced brines has been and continues to be a major concern to producing operators and regulatory agencies. Subsurface disposal is strictly regulated by some state conservation agencies, and disposal of saltwater is not permitted in freshwater streams.

The introduction of oil or brine into water cycles can adversely affect vegetation and aquatic plants, birds, and animals, and fish. Sheltered lagoons and estuaries impose natural dispersal restrictions on oil spills, causing the oil to remain trapped or concentrated in such areas for long periods. Major reductions in water quality that significantly disrupt the food chains by bays, lagoons, and estuaries could have long-term environmental effects.

Hydroelectric Power

Conventional hydroelectric developments convert the energy of natural or regulated streamflows falling through heads created by dammed waterways to produce electric power. Plants are classified as run-of-river or storage projects, depending on the way

in which available streamflow is utilized. In conventional plants, water comes to the plant as a result of natural streams.

Pumped storage projects generate electric power by releasing water from an upper to a lower storage pool and then pumping the water back to the upper pool for repeated use. During off-peak hours when project capacity is not required by the system, water is pumped to the upper pool using energy generated by other sources, usually by large modern stream-electric units. A pumped storage project consumes more energy than it generates. Its economic advantage comes from converting low-cost, low-value off-peak energy to high-value peak capacity and energy and from the highly flexible peaking power it makes available. Pumped storage projects may be designed exculsively as pumped storage or may be included in the design of a conventional hydro-electric installation.

The total conventional hydro-electric power potential of the U.S. at both developed and undeveloped sites is estimated to be about 179,000 MW of capacity. This is broken down as follows:

Table 8-8
Hydroelectric Power Resources of the U.S., Developed and Undeveloped, January 1, 1972

Region	Potential Power (Thou Mw)	Developed Capacity (Thou Mw)	Developed Percent
New England	4.8	1.5	31
Middle Atlantic	8.7	4.2	48
East North Central	2.5	0.9	36
West North Central	7.1	2.7	38
South Atlantic	14.8	5.3	36
East South Central	9.0	5.2	58
West South Central	5.2	1.9	37
Mountain	32.9	6.2	19
Pacific	62.2	23.9	38
Subtotal (lower 48 States)	142.2	51.8	29
Alaska	32.6	0.1	0.3
Hawaii	0.1	–	–
Total U.S.	179.0	51.9	29

Source: Federal Power Commission News Release No. 19370, June 27, 1973.

Although most available sites for economical production of hydroelectric energy have been developed, some additional capacity will be provided by new sites or expansion of existing plants. Use of hydroelectric power to service peak loads enhances project benefits, permitting consideration of possibilities that formerly were marginal or uneconomic under higher capacity factor standards. Multipurpose benefits such as recreation, water supply, fish and wildlife enhancement, and flood control justify projects that would otherwise be uneconomic for a single purpose.

The availability of pumped storage sites largely depends on topography, which has to allow development of a high head between two reservoirs in the same area. In many parts of the country, there are virtually unlimited physical opportunities for developing pumped storage projects. However, only a limited number of sites have been investigated.

ENVIRONMENTAL IMPACT

Impact on Air Quality. Construction activity increases the dust in the air. However, operation of the hydroelectric power plant produces no air pollution, radioactivity, or waste heat.

Impact on Water Quality. Construction often results in temporary increases in stream turbidity. The newly filled reservoir usually has a low dissolved oxygen content. Reservoirs concentrate salt due to evaporation.

Impact on Land Quality. Construction of a hydroelectric dam represents an irretrievable commitment of the land resources beneath the dam and lake. Inundation of the land eliminates wildlife habitat and precludes other uses such as agriculture, mining, and free-flowing river recreation. Some increase in erosion during construction and operation will occur.

Impact on Fish and Wildlife. Fish and wildlife habitat may be significantly changed. The reproductive habitats of anadromous fish may be severely altered by dam construction, unless elaborate provision is made for fish ladders or other means to provide safe fish passage. Significant mortalities of resident and anadromous fish in rivers servicing hydroelectric dams can be caused by nitrogen supersaturation, which occurs at a dam when excess river flow must be passed over the spillway.

Survival studies conducted in 1971 indicate that high nitrogen levels in the Columbia and Snake Rivers pose a serious threat to the future of the salmon and steelhead resources of the region (Power Planning Committee, Pacific Northwest River Basins Commission, 1971). The Corps of Engineers is studying and testing several approaches to the solution of the nitrogen problem.

Nuclear Power

Nuclear energy can be extracted through the fissioning of heavy metals, notably uranium and plutonium, or by the fusion of light elements, notably deuterium and tritium derived from lithium. Fission processes are the most developed. Fission reactors are of two types: "thermal" or "fast." Thermal reactors, including the predominant reactor in the U.S., the light-water reactor, use moderating materials to slow the neutrons. Fast reactors have potential to use a much greater part of the potential energy in the uranium ore.

The use of nuclear power as a commercial electrical energy source is expected to increase considerably in the next 15 years. Installed capacity as of June 1974, was 28,000 MW. This represents about 6% of the nation's electricity. About half of electric power capacity now under construction is nuclear powered.

The construction and operation of additional nuclear generating plants would require additional mining and milling of uranium ore to supply the fuel elements for these plants. As most of the known and potential reserves are concentrated in New Mexico, Wyoming, and the Colorado Plateau, the incremental mining and milling activity would be expected to occur there.

The number of plants in the planning or construction stage indicates that incentives to develop nuclear power facilities are already strong. The inability of utilities to assure long-term supplies of oil and gas has been the greatest stimulus to construction of nuclear plants. However, delays in equipment deliveries, public opposition, environmental objections, and legal difficulties have set back nuclear development.

Future costs of electricity produced by nuclear power are difficult to predict. Factors that tend to lower costs include technological improvements, lower fuel expenditure over the life of the plant, larger plants with economies of scale in capital and operating cost, standard components, and improved construction methods. However, because of the lead times involved, nuclear power plants built as aternatives to the proposed program would have to be planned and built with today's technology.

Factors that tend to increase costs include longer lead time, poor labor productivity, added safety features, higher installed prices for plant equipment, and possibly higher costs of capital. Nuclear plants are expected to be competitive with fossil fuel plants in most areas of the United States.

Given the present energy-using technology, nuclear power can essentially only substitute for oil and gas used by electrical utilities and on-site heating facilities. Even here, it is not a complete substitute. Nuclear power plants are designed primarily for base-load operations; they cannot be expected to displace peaking or cycling units.

ENVIRONMENTAL IMPACT

Impacts on Air Quality. Nuclear power plants, unlike fossil fuel plants, do not emit the usual products of combustion such as particulates, sulphur oxides, and nitrogen oxides. Hence, air pollution problems from such emissions do not occur. However, they do produce radioactive emissions whose release must be strictly limited if adverse effects to the health of humans and other biota are to be avoided.

In normal operation of nuclear generating units, there are small amounts of radionuclides discharged in the cooling water and gaseous plant effluents. Assuming that the present standards will be maintained and enforced, the effects of the amounts released are likely to be negligible.

Impact of Water Quality. Operation of nuclear plants will generate considerable amounts of waste heat due to their comparatively lower thermal efficiency (around 33 percent compared to 40 percent for new fossil-fueled thermal plants). Given this difference in efficiency and the assumption that fossil fuel plants release about 15 percent of their waste heat directly into the atmosphere, a light-water reactor would release approximately 50 percent more waste heat into its cooling water than a fossil fuel plant of similar size (Energy Research Needs, 1971). The effects of this waste heat will depend upon the cooling method used and the location of the plant.

The use of cooling ponds would produce less evaporation than wet cooling towers, but haze, fog, cloud, and ice formation would occur during periods of subfreezing temperatures.

Assuming a 15°-20°F temperature rise, a once-through method of direct discharge into the original source for a 1,000-MW plant would require 270-360 billion gallons of water per year. The effects of using a once-through method of cooling heated water depend in part on the size of the body of water into which this heated water is discharged. The effects along ocean sites, the Great Lakes, and very large rivers are likely to be modest as the heat is more readily dispersed and more easily avoidable by aquatic species. Along smaller lakes and rivers or in bays with limited circulation, the effects can be more significant. Within the affected areas, higher water temperature can produce fish kills, interfere with fish reproduction, disrupt food chains, decrease dissolved oxygen content, drive out desirable aquatic species, and encourage the growth of undesirable algae, which may speed up eutrophication. However, sometimes the heat can be used for aquaculture and other beneficial uses.

Impact on Land Quality. Uranium mining is largely concentrated in relatively isolated semidesert areas distant from large population centers. The removal of vegetative cover and the creation of overburden and waste-rock result from uranium mining. In 1973, 36 percent of production came from underground mines and 62% come from open-pit mines.

Because of low concentration of U_3O_8 in uranium ore, milling the ore produces considerable amounts of low-level radioactive tailings that must be retained in well-constructed tailings dams to prevent erosion and leaching. Tailings are not a suitable environment for future habitation and are unsuitable as fill material in construction for human occupation.

Under current site criteria, nuclear plants would be located at some distance from population centers. Assuming 500 acres per site (based upon an exclusion are of one-half-mile radius around each plant), an average of three 1,000-MW units per site, the construction of 3,000 MW of additional nuclear capacity would thus require 500 acres, from which other uses would be excluded. Cooling ponds require additional acreage (an estimated 1,000 to 2,000 acres per 1,000-MW unit).

Depending on the capacity of the transmission lines needed, the transmission line rights-of-way would require the use of 10 to 15 acres per mile of line. However, transmission lines for electricity are required regardless of how the electricity is produced, whether by nuclear plants, hydropower, or fossil fuel.

Plant construction would present short-run environmental problems, such as the erosion of excavated materials and subsequent siltation.

Control of Radioactive Emissions

Risk of Accidents. The operation of nuclear plants poses some risks of accidents. Nuclear plants are designed to minimize accidents or their adverse effects if one does occur, using a "defense-in-depth" principle. This includes locating reactors far from areas of high population density and designing and constructing plants to prevent accidents and to contain the effects of accidents if they do occur.

Transportation. The nuclear fuel cycle requires the transportation of radioactive materials by truck or rail at several stages. The transportation of spent fuel elements from reactors to processing plants and high-level waste from reprocessing plants to storage sites poses a potential hazard of considerable magnitude. Existing transportation regulations and cask designs have been developed to insure that even if accidents in transporting these materials do occur, no radioactivity will be released to the environment.

Fuel Reprocessing. Spend fuel assemblies from reactors are first partially cooled at the plant site and then tranported to fuel-reprocessing plants where usable nuclear fuel materials are recovered from them and radioactive wastes are separated. At present, there are two such fuel-reprocessing plants, and one more is under construction. Each reprocessing plant can serve 30 to 50 nuclear plants. While radioactive emissions during reprocessing are greater than those occurring during normal power generation, the estimated dose to the affected population is still 2 orders of magnitude below natural levels. Hence, the impact of these emissions is not expected to be significant, even though the chronic effects of such low-level radioactivity are not yet wholly known.

Radioactive Waste Storage. High-level radioactive wastes remaining after reprocessing are first concentrated and stored in solution for 5 years, then solidified, sealed in containers, and put into long-term storage.

An incremental capacity of 1,000 MW would produce around 8,000 to 10,500 gallons of high-level waste per year, using a cumulative storage capacity of 40,000 to 54,000 gallons. This liquid waste, when evaporated, would yield around 80 to 105 cu ft/year in solid waste materials for each year of operation.

Because of their high concentrations of radioactive nuclides and very slow rates of decay, these waste materials must be isolated from the biosphere for hundreds of thousands of years if adverse effects to living organisms are to be totally avoided. Waste is presently being stored in man-made engineered storage facilities below the earth's surface. Pilot studies of storage in salt beds are being conducted.

Geothermal Steam

The greatest potential for geothermal energy in the U.S. exists in the Rocky Mountain and Pacific regions. Some potential exists for the future development of the geopressured systems along the Gulf Coastal Plain of Texas and Louisiana. California leads the nation in the development of geothermal energy. The Geysers field in January 1973 supplied enough steam to four generating plants to result in the production of 300 MW; at the end of 1973, production had risen to 410 MW. The next addition, in 1974, brought the total to 552 MW. From 1975 on, 100 MW of new capacity per year is scheduled to be added with the goal of reaching the 1000-2000 MW range which is the estimated ultimate capacity of the field. Other known Geothermal Areas (KGRAs) are the Imperial Valley, Mono Lake-Long Valley and Salton Sea area in California; areas in Washington, Oregon, Montana, and Idaho have also been classified as KGRAs.

Within twenty years, geothermal energy may account for 1 to 2% of total U.S. energy, but in California, it is estimated to account for 5% of the State's energy consumption.

ENVIRONMENTAL IMPACT

Air Quality. A number of gases are associated with geothermal systems which include ammonia (NH_3), boric acid (H_3BO_3), carbon dioxide (CO_2), carbon monoxide (CO), hydrogen (H_2), hydrogen sulfide (H_2S), methane (CH_4), mercury (Hg), arsenic (As), and argon (Ar). The gases will usually be less than 3 percent of the total steam fraction. The noncondensible gases can pose a pollution and/or health problem. H_2S poses the greatest hazard as far as toxicity is concerned as well as a nuisance odor. H_2 tends to mix with air and the tendency is not to accumulate in local areas except perhaps under severe air inversion conditions.

The second greatest gas problem, as far as volume percent is concerned, is NH_3. This gas, however, is ligher than air and will not accumulate locally. Being readily soluble in water to form ammonium hydroxide (NH_4OH), it is returned to the earth by precipitation where it is utilized in soils as a natural fertilizer.

Generally speaking, development of geothermal energy has a smaller adverse impact on an area's air quality than many conventional fossil-fuel burning power plants.

Water Quality. Most waters associated with geothermal systems are saline; these waters are sometimes more saline than seawater, which contains 35,000 ppm of NaCl alone. The problem is that these saline waters must be disposed of in some manner. If the water quality is good, these waters can be used for irrigation or discharged into streams. If the water quality is poor, the water might be treated and used for various purposes and/or discharged into streams. One practice is to reinject the water into the producing aquifer. NO!

Necessary steps must be taken to insure the integrity of the area's groundwater regimes. Therefore, well construction must be such that no conduits exist between the saline and freshwater aquifers. This can be accomplished by properly using casing, and cementing the casing in place.

Land Quality. Lands in the area of geothermal exploration and development will be changed somewhat. Structures that will be necessary include roads, wells, pipelines, power lines, power plants, etc. These factors are usually not as extensive in geothermal operations as they are in comparable fossil-fuel burning plants.

One significant problem that can come about in geothermal operations

is land subsidence. A decrease in hydrostatic pressure in a confined aquifer results in an increase of the grain-to-grain load on the sediment. The sediment compacts in response to the added load resulting in subsidence of the land surface. This can affect the capacity of canals, drains, sewers, and stream channels due to a change in gradient. Tensional or compressional stresses caused by land subsidence have resulted in structural failures in buildings, pipelines, railroads, bridges, etc. The danger of shear failure in wells is a distinct possibility. Also, compression of an aquifer may cause permanent damage or loss in groundwater storage capacity; this is particularly true with regard to micaceous sandstone formations.

The controlling factors in the subsidence probability of an area's strata are the number, thickness, compressibility, and permeability of fine-grained interbeds and aquitards, their clay mineralogy, and geochemistry of their pore fluids. The occurrence which tends to lead to the most subsidence are those materials which are loosely consolidated, clayey sediments of Tertiary or Quaternary age, particularly those of volcanic genesis, that contain montmorillonite as the predominant clay mineral.

Monitoring subsidence can be done by precise leveling from stable reference points; tidal areas can use mean sea level as the point of reference. Compaction at depth can be measured by the use of radioactive markers, casing collars, and anchored pipes or cables.

Bituminous Sands

Reservoirs of hydrocarbons that are too viscous to be recovered in their natural state and by conventional oil production methods are called tar sands or bituminous sands. Typically, reservoir energy must be added in some manner, either by direct heating, fluid pressure, or mechanical work.

Of the many known North American tar sand deposits, only a few are likely to be of major commercial interest in the next 15 to 30 years. Chief among these are the Athabasca deposits in northern Alberta, Canada, and the Orinoco deposits in eastern Venezuela (U.S. Energy Outlook, 1971). Only five deposits in the United States of 0.5 billion barrels or more are worth considering in relation to affecting U.S. energy supply. All of these deposits are in Utah and are estimated to contain about 17.7 to 17.6 billion barrels of tar sand resources in-place, based on relatively few drill holes supported by outcrop data. Recovery would only be on the order of 30 to 50 percent of the in-place reserves, reducing these reserves to 10 to 16 billion barrels of recoverable oil. Another estimate of U.S. tar sand reserves, based on shallow occurrences only, gives a range of 2.5 to 5.5 billion barrels of recoverable oil (U.S. Dept. of Interior, Bureau of Mines, 1965).

Three states have occurrences of tar sands: Utah, California, and Kentucky. Presently, only in Utah is there any production potential. Furthermore, the Utah deposits are not susceptible to mining, but more likely will be developed by in-situ methods, the technology for which has yet to be developed. In either method, a major shortcoming is a lack of an adequate water supply in proximity to the deposits.

In addition to technological problems, other legal and developmental problems exist. The Tar Sand Triangle and Circle Cliffs giant deposits are largely on Federal lands. Leasing of Federal land for asphaltic minerals or tar sands has been delayed pending legislation.

ENVIRONMENTAL IMPACT

Tar sand development would affect the environment in all phases of development: exploration, mining, production, and transmission of the synthetic crude.

Exploration. Standard exploration techniques are likely to have an effect on the environment. Seismic disturbance associated with initial geophysical surveys delineating the extent of the prospective producing zones would temporarily disturb some domestic animals and wildlife in the area. Other sophisticated methods as gravity and electromagnetics, which are used to determine regional geological structure in the area, would probably not disturb animal life. Exploration drilling would involve access roads, drilling sites, mud ponds, and unattractive storage areas. Soil erosion associated with this activity could affect local surface waters and the fish in time. Drilling operations could contaminate various subsurface aquifers by using certain drilling mud additives or intermixing saline and freshwater aquifers. Debris and wastes associated with any construction and drilling activity could have an impact on esthetics, especially important in tar sand areas due to interest in land use for wilderness areas, recreation areas, national parks, etc.

Mining. Once exploration has determined an area to be profitable, a choice of using mining extraction or in-situ methods will have to be made. The mining extraction method has the advantage of greater recovery, but the environmental disadvantage of large unsightly amounts of tailings and overburden which disturb the ground surface, excavations in both open-pit or underground mining which disrupt the surface, dust and erosion problems which are often associated with tailings, possible contamination or depletion of a local aquifer in a water-poor area, and disruption in wildlife habitat by using tailings areas, mine areas, and associated mining activity.

Although in-situ methods will not face the tailings problems, there are also disadvantages: (a) thermal pollution involved with large amounts of heat put into the ground, (b) possible contamination of aquifers, (c) surface spills due to machinery failures (d) possible surface subsidence with accompanying land disturbance, and (e) noise, depending on the equipment being used.

Processing. A well designed prerefining system of processing tar sands should meet current Federal air standards. The sulfur and nitrogen removed from the bitumen could become a source of air pollution with faulty plant design. Metals removed from the bitumen and associated with carbon residue, unless adequately disposed of, could be a local pollutant. Noise, lighting, and activity associated with a plant could have a detrimental effect on wildlife and esthetics.

Development of the area to house workers and their families will cause associated drains on local water sup-

plies and destroy the natural appearance of the area.

Transporting Syncrude. In this final stage, all the impacts of the other stages will have their cumulative effect. Should any petroleum transporting pipelines be ruptured in the dry remote areas, particularly associated with tar sand resources, considerable time would be necessary to restore the environment. Road transportation by trucks could cause oil spills and dust problems. Rail or pipeline transportation of the syncrude would also be subject to spills through ruptures caused by natural catastrophies or human error.

Hydrogen

Using hydrogen is an alternative to using fossil fuels. Although energy intensive, the greatest obstacles to this relatively pollution-free source of energy are a matter of economics and time. By passing a strong electric current through water in a process called electrolysis, water can be separated into its main gaseous components, oxygen and hydrogen. The hydrogen can be piped as a gas or subsequently liquified and shipped to be used as a fuel.

Before 1958, liquid hydrogen was produced only in small quantities and was primarily a laboratory curiosity. The 1972 hydrogen production was more than 12 billion pounds in the U.S. alone and is used primarily in making refined petroleum products and chemical synthesis. Only a small fraction of this total production comes from the electrolysis of water. Most hydrogen is produced by much cheaper methods of breaking down natural gas, oil, and, to a lesser extent, coal by means of various catalytic streams and partial combustion processes.

Future speculation for massive hydrogen-producing facilities include great floating platforms some miles offshore in the oceans. These platforms would house a series of big nuclear power plants that would generate power for spot decomposition of seawater by electrolysis, the hydrogen produced being piped ashore. The potential advantages of such a system are numerous. Hydrogen gas could be piped to its point of use at about one-eighth the cost of sending an equivalent amount of electricity through high-voltage overhead cables. Underground pipe transmission of gaseous hydrogen would eliminate unsightly overhead wires. Unlike electrical capacity, which is difficult or inefficient to store, hydrogen could be stored as a gas in underground cavities or as a compressed liquid in large insulated tanks to meet fluctuating power demands. Already under development are fuel cells that convert hydrogen and oxygen directly into electricity. Development of advanced electrolytic cells has also begun; these work by feeding in current to catalytically separate oxygen and hydrogen, at a one-fourth to one-third reduction in power required.

The major advances made in hydrogen technology in the last decade are largely spin-offs of rocket and space programs. Liquid hydrogen engines have powered astronauts to the moon and back. In the future, these engines are scheduled to play an even larger role in the space shuttle.

The economics and timing of hydrogen's first use as a fuel are complex matters. Presently, liquid hydrogen is only about 50 percent more expensive than gasoline on a BTU-per-unit-weight basis since liquid hydrogen is so much higher in energy content. Actual cost projections for the electrolytic production of hydrogen range from a low of \$0.04 per pound using electrical energy from a large breeder type of reactor to about \$0.12 per pound for other energy sources. Presently, gasoline costs of production are about \$0.02 per pound. Hydrogen gas is so light, it cannot match natural gas in heat value on a volumetric unit basis. The first hydrogen gas should enter the economy in hybrid gas mixtures that stretch natural gas supplies or may be mixed with synthetic gas products from coal, perhaps before 1980. It is possible to convert present gas lines to handle hydrogen, although at considerable changeover costs. Transmitting costs of the lighter gas would double or triple, and there would be a need for tighter, more carefully maintained pipeline systems, even though the lighter gas would move more rapidly.

With some mechanical modifications, all types of internal combustion engines can burn hydrogen cleanly. In the summer of 1972, at the Urban Vehicle Design Competition, of 63 experimental cars, the two least polluting were cars converted to run on hydrogen, one of which was the only car to exceed the 1975-76 Federal emission standards. Buses, trucks, ships, and locomotives can all run on hydrogen with their present engines, although somewhat less efficiently. It can also be burned in the home for heating or cooling. In any combustion of hydrogen as a fuel, the only major waste produce is water. Additional uses, such as the direct reduction of iron ore, dispense with coal and coke use, as is already being done at several small-scale plants. Production of high-temperature steam for conventional steam power plants is also a future possibility.

With all the exciting possibilities, conversion costs remain extremly high, particularly to the consumer. Enormous investments of capital will be necessary, as will demonstration projects to work out technical problems. It is possible that the use of hydrogen as a fuel could be substantial by the mid-1980s. Large amounts of energy needed for electrolysis could presently be provided only by fossil fuel, which would not relieve supply or environmental problems.

Projections of this alternative remain highly speculative due to its largely experimental nature and its early stage of development.

Biological

Biological energy has attractive prospects in two major areas. One is the production of alcohol from crops, particularly unused crop surpluses, and the other involves the conversion of organic wastes into usable oil.

The efficiency of U.S. agriculture has advanced so fast that for several decades crop production has exceeded demand, except in times of international conflicts and in early 1973, when heavy international buying coupled with unusually bad weather drained surplus stores. Average farm production has increased about 80 percent in the last three decades, largely owing to better yielding seeds

and greatly improved knowledge. Thus, to meet our crop needs, we plant fewer acres and require fewer farmers (New Energy Forms Task Group, 1972).

Agriculture provides the major current source of renewable energy. Forests, cultivated crops, and pasture land may be used repeatedly under proper management. Agricultural production is, however, subject to weather, disease, wind, and other natural conditions that cannot yet be completely controlled. Nevertheless, average production in excess of priority requirements for domestic food, feed, and fibers is believed possible by 1985 and beyond, barring natural disasters or national emergencies. The production of cereal grains and their conversion through fermentation to usable ethyl alcohol fuel, the collection and use of such residue as straws, corncobs, hulls, and shells for fuels, the growing of crops for fuel energy, and the conversion of animal by-products into fuels are all possibilities.

Agricultural fuels would normally be more expensive than such traditional fuels as coal, gas, oil, and waterpower. Increasing U.S. needs for energy, requirements for pollution abatement, and many other economic factors could, however, materially change the future role of agriculture as a source of industrial energy.

Of the approximately 2,260 million acres of U.S. land available, about 25 percent is classified as forest and woodland, and about the same proportion is land suitable for cultivation. Most of our woodland will probably be required to meet the predicted demands for lumber, pulp, and paper industries and thus will offer only minor possibilities for contributing to additional U.S. industrial energy supplies. On an average, however, only about 60 percent of the potentially available cultivated land is now farmed for crops. Yields of cereal grains on these lands have, on an average, increased about 3 percent annually for the past decade. This increase has exceeded the U.S. population growth, even though the amount of cultivated land has decreased. Thus, unused acres constitute a potential source of energy for the foreseeable future.

A logical sequence of energy conversions is to use this land to produce cereal grains, which are largely carbohydrate, and then to convert these grains by fermentation into ethyl alcohol, which is a convenient combustible fuel readily usable in motors. If we assume that the 100 million acres, or about one-half of the acres not now required, are used to produce the grain for alcohol at a yield of 70 bushels per acre, this would be equivalent to about 18 billion gallons of alcohol, or over 20 percent by volume of the 86 billion gallons of motor fuel consumed in the U.S. in 1970. Since ethyl alcohol contains only 65 percent of the energy content of gasoline, on a gallon basis, the actual energy replacement would be only 14 percent.

The cost of this ethyl alcohol from fermentation would be many times higher than the cost of present motor fuel. Even so, this tremendous energy potential must be considered in any assessment of future energy sources.

In 1971, collectable agricultural residues in the U.S. amounted to over 125 million tons annually, with an oil potential of 170 million barrels, roughly equivalent to 47 million tons of low-sulfur coal. To produce the oil from waste, the organic material is treated with carbon and water at 250° to 400°C and 2,000 to 5,000 psi pressure. This oil product has a heating value of 15,000 BTU per pound and the total energy potential would be on the order of 2,000 trillion BTU. High collection and processing costs, incomplete technology, and high capital requirements prevent this energy source from being economically competitive. Presently, only one continuous unit with a capacity of 20 lb per hour is being operated on a test basis. Although the total potential energy from organic waste is enormous and growing, economic considerations will probably prevent this source from having a significant effect on the U.S. energy picture by 1985.

ENVIRONMENTAL IMPACTS

To use crops to create alcohol is not likely to increase pollution. In fact, proper farming techniques would probably reduce soil erosion and increase productivity of the land.

To use animal waste for conversion to fuel would have the obvious advantages of disposing of a pollutant and recycling it into a useful product. Areas of high population density produce greater wastes and would have a locally available source of fuel in proportion to their population. Water quality problems associated with organic wastes could be alleviated. The residue would be sterile, although large amounts of bulk material would still have to be placed somewhere perhaps as landfill.

The oil produced has properties varying with the type of material composing the waste. A distinct advantage in waste conversion would be to reduce demand on natural resources commensurate with the amount of oil and gas made from these wastes.

Solar Energy

Solar energy is a source of both heat and electromagnetic radiation, and possibilities exist for both direct and indirect use of this energy. Fossil fuels are representative of solar energy stored from earlier periods in the earth's history, which, when ignited, release the energy plants and animals accumulated eons ago. Burning fuel, wood, or plants is an indirect use of solar energy. Solid-state solar cells and solar water heating are direct uses.

Four characteristics of solar energy deserve particular note:

1. It is a diffuse, low-intensity source of energy.
2. The energy is spread over various frequencies (i.e., distributed over the various wavelengths of light).
3. Its intensity is continuously variable during the daylight hours, is zero at night, and is subject to weather and seasonal variations.
4. Its availability differs widely between geographic areas.

A consequence of the diffuse nature of solar energy is that it does not naturally produce the high temperatures characteristic of combustion processes. This is a definite disadvantage since high temperatures make possible greater thermodynamic efficiency in energy conversion.

Solar heat can be used for electricity generation, space heating, cooling, and processing of industrial materials. Solar radiation causes

photosynthetic conversion and storage of energy in plants and other photochemical reactions, which also convert and store energy.

Solar radiation produces photosynthesis, which converts and stores energy in plants. To produce power from solar energy used by plants, the energy of the organic material of the plant must be recovered by burning or some other disintegrative process. These conversion efficiencies are very low relative to other processes.

With direct conversion of solar energy, the number and range of potential applications are extensive. However, the present state of technology is such that energy collection efficiencies are low, while the requirements for energy storage resulting from the intermittent nature of the source result in costs that are prohibitive for general use. A typical 1,000-MW power plant operating in a normal solar climate would, with present technology, require 37 square miles of collector surface, assuming efficiency of conversion of solar energy to process heat is to 30 percent and to electrical energy is 5 percent. The many square miles of collector surface that would be required for even a medium-sized power generation facility would have significant impact on the land area, its other use or resource values, and on the general environment. There would be a major esthetic intrusion in desert areas which now are generally unmarred by man's activities.

The silicon cell, developed about 15 years ago, has proved to be a reliable means for this direct conversion of solar radiation to electricity for applications to outer space. The generation of significant amounts of power, however, requires the connection of extremely large number of cells. The capital cost of silicon cell arrays result in power costs in the order of $2.00 to $5.00 per Kilowatt Hour. Thus, the cost is about 1,000 times that of conventional power sources.

Examples of other types of solar generation potential include floating power plants, which would use the solar-produced temperature differentials that exist between the upper and lower levels of Caribbean waters and the Gulf Stream. A second concept deals with the orbiting of space vehicles for the purpose of creating central power generation. Systems such as these have not yet been developed or tested, so they do not represent feasible energy source alternatives that can be considered at this time. Some application for solar heat exists in home heating using relatively inexpensive collectors costing $2.00-$4.00 per square foot and using auxiliary heating when necessary.

As a large-scale source of power, expensive collector areas and low efficiences make it unlikely that solar energy will have any significant impact within the next 30 years.

Tidal Power

Tidal power is a hydroelectric energy source similar to other water power sources. It is derived from the alternate filling and emptying of a bay or estuary that can be enclosed by a dam. The total tidal power dissipated by the earth is enormous, largely accounted for by oceanic friction in bays and estuaries around the world, although theoretically, it could be captured and converted to electric power. Despite this total potential, practical considerations have eliminated all geographic areas except where tidal behavior, range, and water displacement are extremely favorable.

Two plants are presently operating. The larger is the Rance Plant on the Rance River estuary in Brittany, France, which was completed in 1967, at a cost of $90 million. It has a capacity of 240 MW, to be increased to 320 MW. The present cost is about $350/KW. The U.S.S.R. completed its first plant, which has a 1,000 kW capacity, on the White Sea in 1969. Other proposals include the Bristol Channel, United Kingdom; the San Jose Gulf, Argentina; and the western Australian Coast. The Canadian government studied 23 sites on the Bay of Fundy.

The only practical opportunities for economic development in the United States appear to be in the vicinity of Passamaquoddy Bay, Maine, and perhaps Tumangain Bay in Cook Inlet, Alaska. The higher potentials for Cook Inlet are negated by economics and distance from the market. Passamaquoddy Bay has a tidal range of 18 ft. Capital costs of as high as $1 million for the 1.8 billion kW-hour/year were calculated in a detailed 1964 Senate Subcommittee proposal for development. With enormous increase in demand, the significance of this contribution has lessened, and the project has been determined to be uneconomical.

Some possibility exists that with better interest rates and a decline in alternate energy sources, the Canadian government will develop a portion of the Bay of Fundy before 1985. Some of this power could become available to the New England region of the United States. Assuming a maximum of 10 billion kW-hours from this source could be available by 1985, this would still be only 2 percent of the projected electrical energy required by the New England region at that time. The attraction of the renewable nature of tidal energy is a great advantage, although the total amount of energy is relatively low.

ENVIRONMENTAL IMPACT

Environmental problems would be considerable. Although no air pollution would exist, damming with alternate filling and emptying of bay and estuary areas would affect shipping, drainage, sport and commercial fisheries, wildlife, water quality, esthetics, recreation, accumulation of sands and silts, and numerous other uses of present bays and estuaries.

Wind Energy

Energy can be obtained from the wind by means of a device that will extract energy from a moving mass of air. A fixed device can capture kinetic energy by rotation about an axis and, coupled to a generator, convert it into an electrical form. Economical power generation requires an average annual wind velocity of about 30 mph, a nearly constant magnitude, and topography in which boundary layer effects are minimal.

The advantages in using wind energy include: (a) the supply is inexhaustible, (b) it is available in many parts of the world, and (c) the energy is free on the site of production. Some of the practical disadvantages are: (a) the low energy density of the wind, (b) the wind velocity is unpredictable in time and magnitude, (c) the low conversion efficiencies of aeromotors, (d) the effect of icing conditions and weather on aeromotors, and (e) the high capital investment cost.

In Denmark, between 1940 and 1945, when fuel oil was in short supply, 88 wind-driven installations generated 18,000 MW-hours for local needs.

By combining wind-driven generators with diesel standby units, continuous, small-scale, dependable power can be locally generated. This method had supplied lighthouses for over 10 years at several locations, but at a capacity of less than 10 KW. Presently, only one major research project to harness the wind's energy exists. It is at the University of Hawaii and has a budget of just over $100,000/year. If, for example, 10 billion kW-hours/year could be produced from a few large and numerous small generators, then it would reduce the use of conventional fuel annually by four million tons of coal or another equivalent source of energy. However, the high cost of equipment, energy storage, and backup equipment coupled with the intermittent characteristics of the wind preclude a favorable cost benefit of wind energy at the present time. Small-scale use may increase in remote areas where transmission costs prevent conventional power systems, but this impact on the total power picture is negligible. Wind energy does not appear to be an available alternative to traditional large-scale energy sources at this time.

ENVIRONMENTAL IMPACT

The chief environmental advantage of this noiseless air-pollution-free source of electrical energy is in its elimination of conventional fossil fuel use. Secondly, transmission of either the fuel or energy over long distances could be eliminated since the wind is free on site, preferably a site close to the consumer.

The chief disadvantage would be the adverse esthetic effect of a large number of towers with the assorted equipment to adsorb the wind's energy. Associated with this would be land disruptions caused by construction and guying of large towers. Possible injury to soaring birds or damage to the devices themselves by large numbers of birds is a possibility. Heavy weather, icing, and high winds could make such structures unstable and a hazard to the immediate surrounding areas.

2. Energy Conservation

Energy conservation embraces reduction in the production and consumption of energy, expansion in the use of readily available and environmentally acceptable fuels with concomitant reduction in the use of scarce or environmentally-adverse resources, and use of energy which would otherwise be wasted with a decreased need to produce energy from other sources.

Improvement in extraction efficiencies of fuels from present sources is one of the principal options of energy conservation. The extraction efficiencies of oil and natural gas recovery could be increased by fluid injection, earth fracturing by hydraulic pressure, in-site combustion, chemical explosives, and possibly nuclear stimulation. Under current technology, the extraction efficiency of oil is only about 30-35%, leaving 60 to 70% in the ground. Maintenance and acceleration of the rate of improvement in efficiency, will require intensified research and development efforts.

These techniques also apply to wells containing both oil and gas. The principal method of stimulating straight gas wells is hydraulic fracturing. Experiments in nuclear and chemical explosive stimulation of gas wells are being carried out.

Increased production from coal mines with less severe environmental impacts would greatly augment U.S. fuel supplies. Underground mining is increasingly expensive and skilled labor scarce. The adverse environmental impacts of strip mining are coming under increasing criticism. Improved mining techniques, such as long wall and short wall mining, reclamation procedures, desulfurization methods, and coal gasification and liquefaction technologies, would greatly enhance the role of coal among U.S. energy sources.

Greater energy conversion efficiencies in power plants is another area where energy conservation could be achieved. One method of achieving greater conversion efficiencies is an increase in the temperature of the steam supplied to turbine generators. Considerable improvement in this area depends on development of corrosion and erosion resistant materials. Another method is steam reheat. However, more efficient equipment would mean higher capital costs, new materials, and possibly reduced reliability. It is not likely that higher conversion efficiencies will make a major contribution to meeting future energy needs.

On the average, about two-thirds of the total energy output of thermal-electric power plants is released to the environment as waste heat. There is potential to use waste heat from power plants in agriculture, aquaculture, space heating and conditioning, and low-temperature industrial processes. However, various constraints have limited use of waste heat, including economics, season fluctuations, need for scheduling flexibility, and coordination and distance between the power plant and the potential user. Potential applications of process steam include those of waste heat, with the addition of industrial processing and distillation of sewage.

Improvement in efficiency of electrical generation has great potential for energy conservation. The efficiency of large turbine units can be improved by using steam instead of electricity to drive large power plant auxiliary units, such as pumps, fans, and air compressors. However, steam has not yet been used extensively for this purpose because of the cost of long lengths of steam piping.

Pollution abatement and environmental control devices increase energy requirements. The amount of energy required for this purpose can be limited by (1) changes in the energy mix to increase the use of energy sources and end uses that entail less severe environmental impacts, and (2) relaxation of atmospheric and water quality limits.

To the extent that direct combustion of fuel were substituted for electricity, energy utilization efficiences would be improved.

Conservation of energy at the point of end use will receive increasing attention as energy costs rise and fuel supplies are limited. Lifetime operating costs and energy consumption of products, not only initial costs, will increasingly guide equipment and appliance selection. Among end uses, industrial uses, transportation, and space heating constitute for the foreseeable future the largest targets for energy conservation. Table 8-9 shows principal end uses.

Significant savings could be achieved in installation of improved insulation in new and old homes, the use of more efficient space heating and cooling equipment, the shift to more efficient modes of transportation, and more efficient industrial thermal processes.

The major options to achieve transportation savings include increases in engine efficiency, smaller cars, improvement in the balance between transportation modes, and reduction in overall demand for and use of transportation.

Table 8-9
Significant End Uses of Energy in the U.S. (1968)

	Percent of Total Energy Consumption
Transportation (fuel; excludes lubes and greases)	24.9%
Space heating (residential, commercial)	17.9
Process steam (industrial)	16.7
Direct heat (industrial)	11.5
Electric drive (industrial)	7.9
Feedstocks, raw materials (commercial, industrial, transportation)	5.5
Water heating (residential, commercial)	4.0
Air conditioning (residential, commercial)	2.5
Refrigeration (residential, commercial)	2.2
Lighting (residential, commercial)	1.5
Cooking (residential, commercial)	1.3
Electrolytic processes (industrial)	1.2
Total	97.1%

Source: Stanford Research Institute, using Bureau of Mines and other sources.

Industrial thermal processes alone accounted for 28% of total U.S. energy requirements in 1968. The average heat transfer efficiency of individual equipment used in direct heat or process steam operations is not high, about 30%. The overall efficiency of complete thermal processing plants is even lower. By use of new equipment such as fluidized bed combustors, vacuum furnaces and heat pipes, and the application of control for more efficient management of processes, it is estimated that 30% of the energy in thermal industrial operations could be saved.[1]

Table 8-10
U.S. Energy Use by Sector, 1985 and 2000
(Quadrillion Btu)

	Historical Growth		Technical Fix		Zero Energy Growth	
	1985	2000	1985	2000	1985	2000
Transportation*	29	43	21	27	20	19
Industry**	46	87	36	58	34	43
Residential*	24	32	19	20	18	18
Commercial*	16	23	15	18	16	20

*Includes all processing losses of the sector.
**Includes only the manufacturing sector's processing losses.

Source: Energy Policy Project of the Ford Foundation, A Time to Choose, 1974.

The Energy Policy Project of the Ford Foundation[2] studied future energy growth under three scenarios: historical growth, technical fix, and zero energy growth. The technical fix scenario incorporates rising energy prices and government policies that encourage greater efficiency in energy consumption. The energy savings are achieved by presently known technologies that are economically justified at existing prices. If these technologies are used, the energy budget can provide essentially the same level of energy services as the historical growth scenario.

The zero energy growth scenario envisions continuation of economic growth at much the same pace as in the higher energy growth scenarios, with a greater emphasis on services (education, health care, etc.) and durability and quality of consumer goods. The higher prices of energy in this scenario lead to a slightly greater fraction of economic activities that use less energy and more labor. This scenario involves an energy sales tax and, to offset regressive effects, an increase in public services; increased automobile gas mileage through legal performance standards or taxes; and tighter building codes, lending requirements, and capital availability to ensure optimum building design.

Table 8-10 shows energy use by sector for the three scenarios and Table 8-11 shows the required conservation action.

[1] Charles A. Berg, "Energy Conservation Through Effective Utilization," National Bureau of Standards, February 2, 1973.

[2] A Time to Choose – America's Energy Future, 1974.

Table 8-11
Conservation Actions and Savings At $7 and $11 Per Barrel Oil 1980 and 1985
(Savings in Quadrillion Btu's)

Conservation Actions	$7 Oil 1977	$7 Oil 1980	$7 Oil 1985	$11 Oil 1977	$11 Oil 1980	$11 Oil 1985
Transportation						
Establish a mandatory 20 mpg auto efficiency standard	0.38	1.05	2.68	0.26	0.67	1.88
Enact legislation and establish programs that would substantially increase the use of public transit and discourage the inefficient use of automobiles, such as a gasoline conservation fee	1.04	1.12	1.61	0.84	0.89	1.22
Total Transportation Sector[1]	1.42	2.17	4.29	1.10	1.56	3.10
Residential and Commercial[2]						
Subsidy such as a 25% tax credit for retrofit of existing homes, expiring in 1980	0.28	0.45	0.76	0.29	0.47	0.82
Subsidy such as a 15% investment credit for energy reduction investments in existing commercial buildings, expiring in 1980	0.15	0.17	0.20	0.15	0.17	0.21
National thermal efficiency standards for new residential and commercial buildings	0.28	0.54	1.04	0.27	0.51	0.97
Mandatory lighting standards for commercial buildings	0.19	0.25	0.37	0.19	0.24	0.33
Appliance efficiency standards	0.07	0.25	0.65	0.05	0.19	0.47
Total Residential and Commercial Sector	0.97	1.66	3.02	0.95	1.58	2.80
Industrial						
Aggressive conservation programs assisted by R&D for increased efficiency in industrial processes	0.25	0.62	1.22	0.35	0.90	1.50
Total Net Savings[1]	2.64	4.45	8.53	2.40	4.04	7.40
Utilities[3]						
Demonstrations in support of adding energy conservation standards to the Federal Power Act	0.11	0.50	1.01	0.09	0.47	0.91

[1] Savings not entirely additive since auto disincentives would induce some increased new car efficiency.
[2] The gross savings would be higher since losses due to generation and distribution of electricity would be included.
[3] Savings in electrical generation result from decreasing the fossil fuel input required to generate the electricity demand in the three end-user sectors.

Reproduced from: Federal Energy Administration, Project Independence Report, p. 160.

3. Leasing Alternatives

CONTINUE LEASING BASED ON PRE-1971 PROCEDURES

This alternative constitutes resumption of the leasing process which was in effect prior to the Secretary's policy statement of February 1973. This process was primarily conducted in response to application for competitive lease or for preference right lease. After an application was received, a determination was made to lease an area, stipulations were formulated in coordination with the surface managing agency, the sale was advertised, competitive bids were received and the lease was awarded to the highest bidder, if that bid was considered adequate. This process was designed to dispose of known coal reserves in a fair and orderly manner.

In this process, a party could make an application for a prospecting permit. If the existence or workability of coal in the application area was not known, a prospecting permit could be issued. If the permittee demonstrated the existence of coal in commercial quantities, he was entitled to receive a lease. This approach was designed to reward parties who prospected for and located coal.

If this alternative were adopted, leases and permits would still be issued after a careful environmental/reclamation evaluation of each site and full consideration of other resource values. This procedure is in compliance with the National Environmental Policy Act of 1969. Essentially leases would be issued only where impacts on other resources would be minimal and reclamation assured. This is similar to the proposal, but involves single site consideration rather than broader resource planning.

This option will be subject to broad range of State environmental regulations which, in time, may equal or exceed Federal standards.

Site specific environmental impacts and land use conflicts will be essentially the same as those in the proposal. Leasing will be on a site-by-site basis. However, on an area basis, development could be more random than the proposal and create greater conflicting area-wide land use problems such as increased utility and transportation systems along with related growth impacts on rural communities. Such problems, with their associated environmental impacts, are minimized through broader planning incorporated in the proposed program. BLM would lose the ability to regulate the timing aspect of leasing.

CURTAILMENT OR TERMINATION OF FUTURE LEASING AND REVOKE EXISTING VALID RIGHTS

This alternative provides for no further leasing of Federal coal. Existing preference right leases would also be revoked. Federal funding would be required to compensate individuals and firms for the loss of existing valid rights.

It is projected that, should this option develop, one might expect to see as much as eighty percent of the demand for Federal coal transferred to State, private, or Indian lands while another ten percent would be met by coal being transported into an area from outside sources. In addition, the remaining ten percent might be substituted in the form of new gas, oil, or hydroelectric power.

Western Environment

With the exception of a few heavily mined sites, this alternative would not have a significant immediate impact on the physical environment. Federal coal represents only 60 percent of the total Western coal resource of which only 4 percent is now under lease. Mining would invariably increase industrial utilization of private lands.

One important impact of refusing to lease Federal coal would be to put intense pressure on private, State, and Indian lands to become major supply areas, and thus, to become targets for heavy industrialization. The forced development of less than optimum tracts would be inflationary by increasing the cost of goods received.

Another is the impact on otherwise efficient producing units, of being unable to include therein, certain Federal tracts essential to the unit's efficiency. This might contribute to ineffective surface management and rehabilitation inefficiency. Western State governments would be impacted by an increase of surface management responsibility for school and private lands. While most of the Western States are environmentally concerned and have enacted statutes governing strip mining, increased coal development pressures would strain their manpower resources.

Reclamation costs are also greater on small acreage tracts. Withholding Federal leasing would tend to curtail regional exploration of areas not yet fully inventoried. Delays in collecting complete resource data limits the respective State's ability to make comprehensive management decisions.

This alternative would, in many cases, force development of higher

cost resources. In Wyoming for example, over 70% of the strippable coal reserves in the State would be withdrawn. This alternative would result in higher prices for coal and coal-derived energy in areas which are dependent upon Western coal.

Many potential coal gasification products would be eliminated, thus increasing future energy supply problems since gasification is generally considered as an environmentally attractive aspect of coal development.

In the West, Federal lands would be heavily affected by development regardless of whether or not they hosted a mining operation. In some locales, between 80 and 90 percent of the surface is owned by the Federal government. As such, they would be utilized for rights-of-way, new towns, commercial-industrial permits, etc., plus the impacts cited in Chapter III.

In some checkerboarded and scattered ownership patterns, coal development on private lands would still impact on Federal lands even if they are not made available for leasing. In many cases, the broad areas that would actually be affected by mining would be significantly greater than those areas which would be mined if Federal coal were available in conjunction with the intervening private coal. Environmental impacts from coal development in an area can be minimized by planning for coal development which considers the optimum mining of both Federal and non-Federal resources. Development of non-Federal coal resources without necessary development of Federal resources will cause distortion of mining operations with attendant environmental and economic costs.

Wastage of the resource will always exist when an operation bypasses reserves to which rights have not been acquired. It would probably be economically impossible to return at a later date and mine a small tract of Federal coal that was bypassed in the initial operation.

Eastern Environment

The Appalachian States have been the major suppliers of United States coal. Bureau of Mines records show that approximately 41 billion tons of coal were produced in the United States during the period 1890 through 1972; nearly 70 percent of this coal was produced in the Appalachian States. In recent years, production patterns have changed somewhat, but the Appalachian Region still accounts for nearly two-thirds of the Nation's coal production.

Low-sulfur coals are in growing demand in the United States. Although the Western States have an estimated 70 percent of the estimated low-sulfur coal reserve, and our definition of low-sulfur coal is coal with less than 1 percent sulfur, this coal is largely of low rank and has remained relatively undeveloped because it has a lower calorific value and occurs in areas distant from most markets. Because of environmental considerations, there has been some recent development of the western low-sulfur coals. The Appalachian Region, however, still supplied an estimated 80 percent of the low-sulfur coals produced in the United States in 1973.

It is generally accepted that the Western States have the bulk of the Nation's low-sulfur coal reserves and that any stringent enforcement of the air-quality control regulations would rule out the use of most of the eastern coals, with a subsequent movement to western coal development. AQC regulations are based on sulfur dioxide emissions per million Btu of energy input and that, because of its relatively low Btu value, a large part of the western low-sulfur reserve cannot meet established or proposed air-quality standards.

Recent regulations applicable to all major new fuel-burning plants constructed or modified after August 1971 limit SO_2 emissions to 1.2 pounds of SO_2 per million Btu of input. Converted to sulfur content, this means that a coal containing 1.0 percent sulfur must have a calorific value of 16,666 Btu's per pound to comply with the standards. Calorific values of eastern coals average, roughly, 12,000 Btu per pound, and at this value, the maximum allowable sulfur content is about 0.72 percent. Coals that have a calorific value of 14,000 Btu's per pound may have a sulfur content as high as 0.84 percent. On the other hand, western low-sulfur coals probably average about 9,000 Btu's per pound. In order to comply with the standards, their sulfur content would be limited to an average of 0.54 percent.

The Bureau of Mines monitors in-place low-sulfur (0-1%) coal reserves by State. Reserves of depths at 1,000 feet or less are classified into four sulfur content ranges. Only limited reserve information on a sulfur content basis is available for coals deeper than 1,000 feet. While those States with larger low-sulfur reserves at shallow depth might be presumed to have larger low-sulfur reserves at depths below 1,000 feet lack of information makes it risky to extrapolate additional reserves on this basis.

Montana has by far the greatest amount of low-sulfur coal. Wyoming is second and West Virginia is third in reserve rank. Montana and Wyoming coal reserves are mostly subbituminous and lignite. West Virginia reserves are bituminous coal.

States east of the Mississippi River contain some 195 billion tons of bituminous coal reserves of which 83 percent, or 162 billion tons, is susceptible to underground mining only. This is essentially all privately owned coal. However, only about 25 billion tons are classed as low-sulfur (0-1%) coal of which over 21 billion tons would have to be produced from underground mines. These reserves along with smaller non-Federal coal reserves in other States or previously leased coal could theoretically be mined in place of the unleased Federal coal lands in the West. However, much of the 25 billion tons of eastern low-sulfur bituminous coal reserves are reserved for metallurgical and export markets. Further, because of their combustion characteristics they are unsuitable for many steam boilers presently in use.

The impacts of mining privately owned or federally owned western coal would be identical, assuming the same mining methods were used. However, if no additional Federal lands were leased, the areal extent of mining private coal and of its impacts would be greater. In other words, the number of acres mixed could be essentially the same but the location of those acres would be more widespread if intervening Federal lands were not mined. Impacts of surface and underground mining are discussed in Chapter Three.

Impacts of mining eastern low-sulfur coal would differ from those of mining western coal. As about 85 percent of the eastern coal would have to be produced from underground mines, there would be less surface disturbance, but the problem of acid mine drainage would be greater. Current statistics are not available that show production by coal seam thickness. A 1965 Bureau of Mines report (IC 8345) indicates that western strip mined coal seams are over three times thicker than eastern coal seams. With the difference in recovery between underground and surface mining methods (1:1.6) this means that about five times the area will be affected by an equivalent tonnage of western coal production. With the newer western strip mines opening coal seams of 50 feet thickness and over, this ratio will become even greater – possibly 20:1 at some mines. Most of the eastern production would have a large areal extent, including all of the Appalachian States and the interior province States of Indiana, Illinois, and western Kentucky.

Another factor affecting eastern coal production is the average productivity per man-day. In 1973, underground production per man-day was less than one-third that for strip mining – 11.2 tons vs 34.9 tons. Underground productivity has been in a declining trend (30%) since 1969, the year the Health and Safety Act of 1969 was implemented. The high was 15.6 tons per man-day during that year. Future underground productivity is expected to rise again, however, to an estimated 14 tons per man shift by 1985. The Federal Energy Administration's Business as Usual Scenario (the most conservative estimate) of Project Independence forecasts a need for about 1.14 billion tons of coal annually by 1985. About 40 percent (460 million tons) of this is contemplated from underground production. If underground mining was substituted for only one-half of the expanded surface mine production (340 million tons) a total of nearly 254,000 underground miners producing 14 tons per man-day would be required to meet this 0.8 million ton output, based on working 255 days per year. This compares to a 1973 total of 158,000 miners employed in the coal industry. Even today, mining companies are having difficulty in finding people willing to work underground, let alone trained miners. Unless there are compelling circumstances in the American labor force, it appears that expansion of underground coal production may be limited by the inability of mining companies to attract and train a viable working force. One of the deterrents to attracting a labor force is the traditional high fatality rate of underground mining which is more than double that for surface mining. For the 4-year period 1970-73, there were 603 underground fatalities compared to 88 for surface mining. While the labor picture is not especially bright for eastern underground coal production, one advantage over western mining is that the labor market is much larger in the East and therefore the potential for satisfying labor demands is more favorable in the East. However, regional displacement of the mining population to eastern States with low-sulfur coal reserves from those with high-sulfur coal reserves would not mitigate adverse socio-economic impacts that might exist from western coal development.

There are two areas where development of eastern low-sulfur coal would have less impact than developing western coal. One of these concerns the heat value of coal. Bituminous coal has an assumed heat value that ranges between 11,500 and 13,500 Btu's while subbituminous coal has a value of 9,000 Btu's and lignite a value of 6,750 Btu's. Eastern bituminous coal therefore has a 35 percent greater heat value than western subbituminous coal.

A second area wherein eastern coal would have less impact is that of surface mining reclamation. As most of the eastern coal lies in areas conducive to agriculture and having upwards of 50 inches of annual rainfall, chances for successful revegetation and returning the disturbed land to productivity is much greater than for western coal. Actual practice as well as research projects (dating back to the 1930s) have been underway east of the Mississippi for many years. While more can be learned, many reclamation techniques are tried and proved. The lack of rainfall, less than 15 inches in much of the West, appears to be the greatest obstacle to overcome when planning revegetation. Reclamation is discussed in detail in Section IV under the heading *Soils and Vegetation*.

Western low-sulfur subbituminous coal is particularly attractive in the electric generation sector of the economy for midwest markets and for future gasification and perhaps liquefaction plants. While it will be necessary to draw on many available low-sulfur coal resources to supply the projected energy demand in the United States, the indicated demand for western low-sulfur coal is strong. Projected cost figures indicate that gas from western coal gasification would be less expensive to produce: \$0.68-\$0.96/million Btu compared with eastern coals' \$.96-\$1.29/million Btu (NPC, 1973 Coal Availability).

Federal coal development in the West would not exclude the need for developing the largely private low-sulfur eastern coals, particularly in West Virginia where competition could be maintained, offsetting higher production costs by lower transportation costs or transmission losses for nearby eastern markets.

The major markets for Appalachian coals in the next decade or so will be essentially those of the present; that is, electric-power generation, coke production, and exports. All markets except those for domestic coke production are expected to increase substantially.

Conversely, it is also apparent that development of eastern coal alone could not be substituted for developing the large reserves of western coal needed to satisfy expanding energy requirements and insure energy self-sufficiency set forth in the Project Independence Blueprint. Changes in air quality standards or extension of implementation dates could change the production picture considerably.

Continued or expanded eastern coal production will have the effect of retaining established populations in Appalachian communities. Existing life styles will be perpetuated and current regional economic decay would perhaps be reversed. Transportation systems and utilities are already constructed much more extensively in the East than in the West. As such, expansion of the eastern coal industry would not require the degree

of pioneer construction (roads, railroads, pipelines, power) as needed elsewhere. In summary, eastern coal development would impact upon less surface terrain that western coal since it will be predominantly underground mining. Use of the surface will, however, be of a longer duration.

GRANT NO NEW COMPETITIVE LEASES BUT HONOR EXISTING VALID RIGHTS

This alternative involves development of existing leases and leases which will result from valid applications prior to undertaking additional leasing. Analyses of existing leasing indicate that: (1) Existing leases are not necessarily in the ownership of companies needing coal reserves for early production; (2) Some of the coal lands under lease are broadly scattered and lack potential for development due to isolation and limiting transportation facilities; and, (3) Some leases, by themselves, contain inadequate lease reserves to support economic mining operations or Logical Mining Units (LMU). The effects of this alternative would be similar to those described in Alternative 2, but would be somewhat less critical. Companies needing western coal would be forced to develop state, private, and Indian lands, the impact of such development without the capability of mining related Federal lands has been addressed in prior alternative discussions.

CONTINUE LEASING SUBJECT SOLELY TO THE SECRETARY'S FEBRUARY 1973 SHORT TERM CRITERIA

Coal leases will be issued only under the following conditions:

- When coal is needed now to maintain an existing mining operation; or
- When coal is needed as a reserve for production in the near future; and
- When the land to be mined will in all cases be reclaimed in accordance with lease stipulations that will provide for environmental protection and land reclamation; and
- When an environmental impact analysis covering the proposed lease has been prepared subject to the National Environmental Policy Act.

Under this alternative, no prospecting permits would be issued. Competitive lease sales would be held only pursuant to the short term leasing policy announced by the Secretary when the moratorium in February, 1973, was imposed. That policy dictates that leases would be issued only when needed to maintain existing mines or as a reserve for production in the near future and only when the land will be reclaimed in accordance with stipulations included in the lease and after compliance with the National Environmental Policy Act of 1969. This alternative restricts the entrance of new parties into the mining of Federal coal. The party must either have an existing mine or be able to demonstrate the need for the coal as a reserve for production in the near future which requires the party to have the coal committed before the lease is awarded. The impacts of this alternative would be similar to those identified in the pre-1971 procedure since leases are considered on a site-by-site basis. This system would generally provide for concentration of development in or around existing operations.

The Department would have only limited flexibility in determining what areas would be considered for leasing and therefore could not choose sites from the entire Federal holding based on least environmental impact and ability of areas to absorb additional or new mines.

The difference environmentally between this approach and the proposed program is that, using the latter, BLM can on an area basis regulate the timing and location of leases in a more efficient manner based upon a broader choice of potential tracts. Although it will tend to prevent immediate deficiencies in supplies of coal which are necessary to meet our continuing energy needs, it will invariably discourage accelerated development on a broad and well planned basis.

SHORT-TERM LEASING CRITERIA IN CONJUNCTION WITH HONORING EXISTING RIGHTS

This modifies the previous alternative by including the issuance of preference right leases which result from prospecting permits now in effect if the leases are environmentally acceptable.

Environmental impacts are essentially the same as those described for the pre-1971 alternative except that competitive leasing would be constrained and no new prospecting permits would be issued. This system requires planning and processing leases on a case-by-case basis which may result in areas being mined in less than the most effective manner in regards to both the environment and economics. Under this system, industry or the government may not always, under the short-term criteria, be able to get the most logical or desirable unleased tracts into the market place.

INITIATE AN ALL-COMPETITIVE LEASING PROGRAM AND HONOR EXISTING RIGHTS

This option is essentially the same as the program proposal except that it does not allow for resumption of the issuance of prospecting permits in the future; environmental impacts would be identical in scope, intensity, and magnitude.

INITIATE AN ALL-COMPETITIVE LEASING PROGRAM AND REVOKE ALL EXISTING LEASES WHICH FAIL TO SATISFY NEPA OR MEET DILIGENT DEVELOPMENT REQUIREMENTS AND ALL EXISTING PROSPECTING PERMITS OR PREFERENCE RIGHT LEASE APPLICATIONS WHICH CANNOT BE DEVELOPED IN AN ENVIRONMENTALLY ACCEPTABLE MANNER

This alternative is similar to the proposed program and to the all-competitive leasing program above, except that it requires revocation of all leases which cannot be developed in an environmentally acceptable manner or which are not being diligently developed and all preference right lease applications or prospecting permits which cannot be developed in an environmentally acceptable manner. Environmental impacts are similar to the proposal except that greater control of leasing is inherent in this alternative. The diligent development

requirements should, in time, have the effect of forcing relinquishment of environmentally marginal existing leases. This alternative would result in less environmental impacts than would the proposed program. It would require very significant funding to enable the Federal government to compensate holders of valid existing rights to be revoked.

LIMIT LEASING TO NON-SURFACE MINE TRACTS

This alternative would result from the Federal Government issuing leases only on those tracts that are suited to underground operations. It would force surface mine development on State, private, and Indian lands.

The National Safety Council indicates in their 1973 Edition of Accident Facts that the 1972 injury rates by industry show the frequency rate for disabling injuries per one million man-hours is 9.24 for surface mining contrasted to 37.41 for underground coal mining. Of all industries included in the National Safety Council reporting system underground coal mining shows the most frequent number of disabling injuries per 1,000,000 man-hours while the frequency rate for surface mining is lightly below the oil industry average of 10.17. The severity rate (days charged for work injuries per 1,000,000 man-hours exposure) for surface mining is 1,832 days compared to 4,232 days for underground coal mining. Again, the severity rate for underground coal mining exceeds all other industries reporting to NSC. It should be noted that industry rankings are not exact because of variation from industry to industry in the proportion of companies which maintain accident records and send reports to the National Safety Council; they are, however, indicative.

Several mining factors limit the use of underground sites in preference to surface mines in the West. First, current techniques of coal mining and the overburden characteristics preclude good recovery of seams that are over 15 feet thick.

Restriction of surface mining could essentially have the same long term effect of forcing future eastern development and non-Federal western development as the prior cited alternative of limiting future leasing with attendant increased economic and environmental costs.

Subsidence cannot be properly controlled in shallow deposits. Continued movement and collapse of the surface in random patterns and over many years can easily cause more disruption for a longer period than a properly managed and rehabilitated surface mining operation. Subsidence not only makes surface use hazardous but also destroys land form and jeopardizes water quality.

Cost to the consumer is another adverse factor to underground mining. The difference between the two methods can easily be $5.00 per ton, which is a significant burden to be assumed by ultimate users, and a deterrent to economic growth. Underground mining is also of a greater duration than short term strip recovery.

In summary, underground mining results in less natural resource impact than strip mining. Underground operations do not disturb vast acreages of soil and vegetation and reclamation would essentially involve the removal of buildings, portals, closing of shafts, etc. While portal structures and mine buildings are never aesthetically pleasing, they are at least confined to a relatively small area or site. However, underground operations are hazardous to the people who must work in them.

LEASE ONLY WHERE THE SURFACE AND SUBSURFACE ARE FEDERALLY OWNED

Ownership of total surface and subsurface rights would enhance both administration and surface protection. This type of program could be accomplished by legislation or Secretarial Order directing Interior to limit future leasing to only those tracts where total fee is owned by the Government.

This alternative may prohibit surface mining on approximately 43 million acres. Seventy million acres would be indirectly affected because as much as 20% of the land could be precluded from surface mining due to scattered non-economical mining units set up by checkerboard land ownership patterns. The coal lands would similarly be severly affected by this Amendment. In the Birney-Decker area, which contains the best coal deposits, 85% of the coal could not be mined.

This alternative would result in mining on a much broader, less efficient scale with a resultant broken pattern of operations. Tracts of Federal land with Federal coal resources and non-Federal coal lands adjacent to lands where the Federal government owns the coal but not the surface might not be mined or might be mined in a distorted manner which would cause high economic and environmental costs to be incurred.

It is estimated that 14.2 billion tons of federally owned strippable coal are within lands of which the surface rights are held by other interests. Thus, as much as 31% of the total strippable recoverable coal resource in the 8 Western conterminous coal leasing States could be adversely affected.

Nearly half of the surface embraced by existing Federal coal leases is privately owned. Applying the percentage of privately owned surface to the total surface minable, coal reserves under lease gives an estimate, by States, of 6.3 billion tons of the 919 billion tons of reserves under lease that could be disqualified from mining.

FEDERAL DEVELOPMENT OF COAL

It has been proposed that the Federal Government actively conduct its own exploration for and subsequent development or extraction of energy fuels. This would result in more systematic inventories of coal reserves. The Federal Government would not be limited in exploration by acreage or lease boundaries. It would provide more complete knowledge as to the extent of a given coal field.

Exploration and development by the Federal Government would be responsive to the National energy emergencies. This alternative would probably require enabling legislation.

The Federal Government would be subject to not only its own regulations, but considerable public scrutiny. Environmental impacts would be similar to that of the proposal. This alternative would require production, distribution, price type decisions that have traditionally been handled by private firms and individuals.

Chapter Nine

Analysis of Public Comment

Analysis Of Public Comment

CONSULTATION AND COORDINATION IN THE DEVELOPMENT OF THE PROPOSAL AND IN PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

The draft environmental impact statement was prepared by an interdisciplinary team comprised of individuals from the U.S. Department of the Interior and the Forest Service, under the leadership of the Bureau of Land Management. Expertise in wildlife biology, outdoor recreation, range management, hydrology, geology, mining engineering, archeology, history, landscape architecture, forestry and law. In their search for and in the data gathering process, team members toured typical coal development areas, and developed and maintained contact with federal/state agencies, mining companies, universities, and individuals concerning specific areas of the draft statement for which they had specific expertise.

COORDINATION DURING THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

Distribution

The draft environmental impact statement was completed during the fall of 1973 and was filed with the Council on Environmental Quality on May 5, 1974, and a notice of its availability published in the *Federal Register* on May 9, 1974. Approximately 1,100 sets of the two-volume draft statement were initially distributed to federal and state agencies, U.S. Senators and Representatives, industry organizations, mining companies, conservation and environmental groups, libraries and others. During the review period an additional 1,000 sets were distributed to other requesting organizations and individuals. Comments were requested from all recipients of the draft environmental impact statement. Four months were allowed for submission of comments ending August 30, 1974.

Written Comments Received

One hundred seventeen (117) documented comments were received as a result of solicitation by news releases, *Federal Register* notices, distribution of the draft statement, and in connection with the five public hearings. It is difficult to estimate the total number of persons represented by these written comments as many letters were from industrial groups and from conservation and environmental protection groups and organizations.

Public Hearings

Public hearings were held in Salt Lake City, Utah; Billings, Montana; Casper, Wyoming; Denver, Colorado; and Bismarck, North Dakota on August 12, 14, 16, 19, 21, 1974, respectively. The purpose of these hearings was to receive views, comments, and suggestions relative to the draft environmental impact statement. At the conclusion of each witness' testimony, members of the hearings panel questioned the witness to clarify or expand witness testimony.

Garry V. Fisher, Administrative Law Judge from the Department of the Interior's Office of Hearings and Appeals, Billings, Montana, conducted the hearings. A panel of officials representing the Secretary's Office, U.S. Department of the Interior, the Bureau of Land Management and the Geological Survey received the testimony.

Total oral testimony at the five hearings was given by thirty-seven (37) persons. A complete transcript of each public hearing plus written comments are available for public inspection with the Bureau of Land Management, Washington, D.C.

PUBLIC RESPONSE

Comments and testimony were received from a diverse group of individuals, groups, organizations, companies, and agencies. Comments ranged from support of the statement to requests for a complete rewrite of the statement. However, two areas of major concern were readily apparent. These were: (1) need for a more detailed description of the proposed Federal coal leasing program primarily as it details the Energy Minerals Activity Recommendation System (EMARS); and (2) need to further analyze the nation's need for additional Federal coal in light of the large acreage and coal reserves presently under lease but on which no development has taken place.

All letters and comments received were first reviewed relative to either draft corrections or issues raised. Academic or technical corrections were then subsequently made into the final document. All substantive issues were divided into the following four categories and analyzed to determine revisions necessary to strengthen and improve upon the final statement.

- Technical Issues
- Program Policy Issues
- National Environmental Policy Act/ Council on Environmental Quality Issues
- Legislative Issues

The latter portion of this chapter contains copies of correspondence received from Federal agencies, State governments, conservation organizations, and key spokesmen groups whom were felt to represent large sectors of the national economy. Due to the bulk of some organizational input, several summaries are contained in lieu of the voluminous original documents even though the total documents were evaluated by the Department.

Response to and Disposition of Specific Issues

Technical Issues

TECHNICAL ISSUE NO. 1

The document must explicitly describe the proposed EMARS process. The DES lacks focus on the nature of the program.

Issue Raised By:

Natural Resources Defense Council, Incorporated
U.S. Bureau of Mines
Colorado Open Space Council
Sierra Club
National Coal Association
Northern Plains Resource Council (Kit Muller)
Environmental Impact Assessment Project
Pat Ford (Idaho Falls, Idaho)
State of Montana
Donald C. Grey (Salt Lake City)
Council on Environmental Quality
Environmental Protection Agency

Response The description of the proposed EMARS process has been rewritten and expanded to reflect comments and suggestions received.

TECHNICAL ISSUE NO. 2

The DES fails to describe its purpose and relationship to other federal programs.

Issue Raised By:

National Resources Defense Council, Incorporated
Larry Edwards (Rock Springs, Wyoming)
James Goodwin (Denver, Colorado)
Northern Plains Resource Council (Kit Muller)
Environmental Impact Assessment Project
National Coal Association
Council on Environmental Quality
Environmental Protection Agency
Fish and Wildlife Service
North American Coal Corporation

Response

The purpose of the EIS is to consider the broad environmental impact of the leasing of coal by the Bureau of Land Management utilizing EMARS, the alternatives to leasing and to provide a tool for use in decision-making which can be drawn upon, supplemented and updated.

The EIS is not intended to deal with the issues of how much coal should be leased or what specific areas should be leased. These factors will be the subject of other studies.

There are several on-going federal, state and private studies and programs in and related to coal in the western states. Some of these, such as, The Northern Great Plains Resources Study and The National Science Foundation Reclamation Study, were considered in writing the EIS, even though the studies were not complete. These and other studies and programs will be considered with respect to decisions on the future regional or specific leasing proposals.

TECHNICAL ISSUE NO. 3

The nation's coal needs are not covered adequately plus the role of federal coal.

Issue Raised By:

Natural Resources Defense Council, Incorporated
National Coal Association
Environmental Impact Assessment Project
Pat Ford (Idaho Falls, Idaho)
Sierra Club
Council on Environmental Quality
Environmental Protection Agency
North American Coal Corporation

Response

As stated in the previous response the issue of the amount of coal to be leased is not within the scope of the EIS.

TECHNICAL ISSUE NO. 4

The DES overestimated recoverable reserves.

Issue Raised By:

Vickers Energy Corporation

Response

Changes in the text on page 1-44 and in Table 1-11 reflect the corrections suggested. The new Table 1-11 shows an in-place coal "Reserve Base" of some 437 billion tons. Application of recoverability factors to this in-place "reserve base" would result in figures much more in line with those suggested by the reviewer.

TECHNICAL ISSUE NO. 5

The DES lacks comparison of eastern versus western coal development.

Issue Raised By:

Natural Resources Defense Council, Incorporated
West Virginia Legislative – Senate Mines and Mining Committee
Lynne Bama (Wapita, Wyoming)
City of Charleston (West Virginia)
Ellen Pfister Withers (Billings, Montana)
Environmental Impact Assessment Project
Sierra Club
Peabody Coal Company
Governor Link (State of North Dakota)
Council on Environmental Quality

Response

A new section under Leasing Alternatives, Chapter VIII, contains an assessment of the development of non-Federal Eastern and Western coal reserves rather than leasing additional Federal coal lands.

TECHNICAL ISSUE NO. 6

The DES should compare eastern coal to western coal on a BTU/SO_2/water basis.

Issue Raised By:

North Dakota Wildlife Federation, Inc.
West Virginia Legislative – Senate Mines and Mining Committee
Environmental Impact Assessment Project
Governor Link (State of North Dakota)

Response

An addition to the coal classification section of Chapter I of the final EIS explains High BTU, Low BTU, High Sulfur, Low Sulfur, interrelationships. Water content directly affects BTU content and therefore is discussed in this section.

TECHNICAL ISSUE NO. 7

The DES understates the available supply of eastern and midwestern low sulfur coal.

Issue Raised By:

West Virginia Legislative – Senate Mines and Mining Committee
City of Charleston (West Virginia)
Environmental Impact Assessment Project
Governor Link, State of North Dakota

Response

The curtailment of further Leasing Alternatives, Chapter VIII, discusses development of non-federal coal reserves rather than leasing additional federal coal lands. Non-federal western coal as well as eastern coal is available and both these sources are covered in the final statement.

TECHNICAL ISSUE NO. 8

The DES fails to adequately compare strip mining to underground mining.

Issue Raised By:

West Virginia Legislative – Senate Mines and Mining Committee
Environmental Impact Assessment Project
Natural Resources Defense Council
Sierra Club
Kerr-McGee Corporation

Response

Separate discussion of strip and underground mine facilities, equipment and methods is given in Section I of the Statement. Strip and underground mining are discussed individually throughout the sections on Impacts, Mitigation of Impacts, Permanent Effects of Mining and Alternatives to the Proposed Action.

There is no attempt to weigh the good and bad effects of one method against the other, and to arrive at a conclusion that one method should be used exclusively.

Both methods have impacts which will differ with each individual mining situation. The choice of mining methods or whether to mine at all must depend on the deposit to be mined, its location and its relationship to other resource and human values. This statement does not address individual mines, deposits or locations. Future environmental analyses for an individual proposal will address these specifics and the advantages and disadvantages of proposed mining methods in regard to particular deposit.

TECHNICAL ISSUE NO. 9

The DES reflects inadequate technology relative to underground mining.

Issue Raised By:

West Virginia Legislative – Senate Mines and Mining Committee
Environmental Impact Assessment Project
Environmental Protection Agency

Response

Chapter I discusses the methodology of various underground mining techniques. Chapters III and IV also discuss the impacts and mitigating measures, respectively, of various methods of surface and underground mining.

It is not the purpose of this statement to discuss all the intricacies of various mining methods, but to identify those aspects which will have an impact upon the environment and to assess these impacts.

TECHNICAL ISSUE NO. 10

The DES failed to fully describe how the government will administer the leasing-development program.

Issue Raised By:

Colorado Open Space Council
Carter Oil Company
James Goodwin (Denver, Colorado)
Environmental Impact Assessment Project
Sandia Mountain Wildlife and Conservation Association
Sierra Club
Peabody Coal Company
Jack McNulty, Stanton, North Dakota
Council on Environmental Quality
U.S. Department of Agriculture, Forest Service
Environmental Protection Agency

Response

The administrative roles of the various government agencies involved in the leasing of Federal coal deposits are discussed on page 1-62 of the final statement. The Department believes that this section clearly identifies the administrative and supervisory function of each Federal agency involved.

Chapter I has also been rewritten to clarify the coal leasing program and should resolve many of the questions generated by the initial draft statement.

TECHNICAL ISSUE NO. 11

The DES reflects a lack of interagency coordination.

Issue Raised By:

Natural Resources Defense Council, Incorporated
Lynne Bama (Wapita, Wyoming)
Environmental Impact Assessment Project
Bureau of Reclamation
Fish and Wildlife Service

Response

The coordination efforts undertaken during the preparation of the final Impact Statement are discussed

in Chapter IX and do not reflect a lack of interagency coordination.

TECHNICAL ISSUE NO. 12

The DES inadequately discusses coal development demands upon the nation's water resources.

Issue Raised By:

Geothermal Energy Institute
Environmental Impact Agency, State of New Mexico
Sierra Club
Pat Ford (Idaho Falls, Idaho)
Pennsylvania Department of Environmental Resources
Charles F. Metzger, North Dakota State Planning Division
U.S. Geological Survey
Environmental Protection Agency
Bureau of Reclamation
State of Texas

Response

A large portion of the western coal deposits are in semi-arid areas. Chapter III points out that the onsite power plants, coal gasification plants and coal liquification plants projected for the semi-arid western United States will consume large quantities of water. The use of large quantities of scarce water will in some cases eliminate other possible beneficial water uses. The availability of water for energy development is extremely variable from site to site. The question of water availability for energy development without adversely affecting other essential water requirements will be assessed in great detail on a site-specific regional basis as development plans are proposed.

TECHNICAL ISSUE NO. 13

Future leasing should ensure that water quality in the river systems not be degraded.

Issue Raised By:

Colorado River Board of California
Lynne Bama (Wapita, Wyoming)

Response

It is beyond the scope of this statement to analyze the possibility of water quality degradation on all the nation's river systems. This issue will be assessed on a site-specific basis as subsequent plans are developed. Federal and State laws pertaining to water quality provide criteria and standards which must be met by any development. Leases issued will require conformity with established State and Federal water quality standards.

TECHNICAL ISSUE NO. 14

Site oriented hydrologic impacts from exploration or production were not adequately discussed.

Issue Raised By:

Geothermal Energy Institute
Francis J. Walcott (Absarokee, Montana)
Ellen Pfister Withers (Billings, Montana)
Environmental Impact Agency, State of New Mexico
Mr. and Mrs. E. M. Kivver (Forsyth, Montana)
U.S. Geological Survey
Charles F. Metzger, North Dakota State Planning Division
Environmental Protection Agency
State of Texas

Response

Hydrologic impacts were by necessity discussed in a general way. Specific impacts on hydrology will be discussed by site as specific development plans are proposed.

TECHNICAL ISSUE NO. 15

The DES overstated adverse mineral development impacts or land uses in relationship to other benefits.

Issue Raised By:

Burlington Northern
El Paso Natural Gas Company
U.S. Bureau of Mines
Kerr-McGee Corporation
National Coal Association
Getting Oil Company
Gulf Mineral Resources Company
North American Coal Corporation

Response

The Department does not believe that the adverse impacts were overstated in relation to benefits. We do, however, realize that the actual benefits derived from coal development when weighed against adverse impacts resulting from coal development vary significantly from area to area. A detailed analysis of impacts and benefits will be done for each individual site as development plans are made and submitted.

TECHNICAL ISSUE NO. 16

Environmental impacts from mining are underemphasized.

Issue Raised By:

Environmental Impact Agency, State of New Mexico
Environmental Impact Assessment Project
Governor Link, State of North Dakota
Bruce Hagen, North Dakota Public Service Commission
Charles F. Metzger, North Dakota State Planning Division
Terance Lamb, United Plainsmen Association
Society of Vertebrate Paleontology
Atomic Energy Commission

Response

The environmental impacts of mining western coal lands are broadly discussed in the final impact statement using the best information available at the time. The writers tried to use an objective approach in describing the environmental impacts, in a general way, resulting from coal leasing in the United States. However, a detailed discussion of regional or local environmental impacts resulting from coal leasing will be included in each site-specific proposed coal leases minerals activity plan and environmental assessment.

TECHNICAL ISSUE NO. 17

The DES is deficient in addressing the effects of trace elements and radioactive contaminants.

Issue Raised By:

North Dakota Wildlife Federation, Inc.
Utah Environment Center
Environmental Impact Agency, State of New Mexico
Environmental Impact Assessment Project

Sierra Club
U.S. Geological Survey

Response

Research oriented toward trace elements and radioactive contaminents and their effects as a result of coal development is in its infancy. The possibility of adverse effects are broadly addressed in this statement. The magnitude and actual impacts from trace elements and radioactive contaminants will vary by site, mining methods, coal quality, and use of coal. Assessments further defining the actual impacts expected from trace elements and radioactive contaminants will be addressed on a site-specific basis as subsequent plans and proposals are developed.

TECHNICAL ISSUE NO. 18

The DES inadequately addresses historical-cultural values.

Issue Raised By:

National Park Service
Environmental Impact Assessment Group
Society of Vertebrate Paleontology

Response

As stated in Chapter I of the final statement, this is a programmatic statement addressing the existing environment and impacts resulting from a federal coal leasing program in a general way. The extent and amount of historical-cultural values encountered on federal land varies considerably from area to area. It is imperative that these values be thoroughly assessed on a site-specific basis as specific plans and the proposals develop protective and data retrieval measures are discussed in the chapter on mitigating measures.

TECHNICAL ISSUE NO. 19

The DES inadequately addresses the social-economic aspects of current and future coal development.

Issue Raised By:

Francis J. Walcott (Absarokee, Montana)
Lynne Bama (Wapita, Wyoming)
North Dakota Wildlife Federation, Inc.
North Dakota State Planning Division
Soil Conservation Service (Washington)
Colorado Division of Planning
Raymond L. Gold
James Goodwin (Denver, Colorado)
Amax Environmental Services Group
Sierra Club
Rosebud Protective Association
Iowa Confederation of Environmental Organizations
Council on Environmental Quality
U.S. Department of Agriculture, Forest Service
Atomic Energy Commission
Environmental Impact Assessment Project
Mr. and Mrs. E. M. Kivver (Forsyth, Montana)
Pat Ford (Idaho Falls, Idaho)
State of Montana
Donald C. Grey (Salt Lake City)
State of Montana (Bill Christianson)
Governor Link (State of North Dakota)
Bruce Hagen, North Dakota Public Service Commission
Charles F. Metzger, North Dakota State Planning Division

Response

The proposed action is resumption of the federal coal leasing under a managed program. No overall level of leasing is projected and leasing goals are not recommended by area or region. Therefore, specific socio-economic impacts cannot be projected and are beyond the scope of the programmatic statement.

The statement recognizes the potential for significant socio-economic impact due to the extensive Federal coal resource and the fact major deposits are primarily in rural areas. Thus, the statement generally discusses the socio-economic aspects in the section on Impact and Mitigating Measures. The magnitude of socio-economic impacts and mitigating measures will be assessed in greater detail for site-specific proposals.

Proposals for leasing will be studied on an individual basis as to socio-economic impacts and cumulative effects will be examined as appropriate. These studies will specifically explore both the primary socio-economic impact of coal mining and at some point in time coal transportation or utilization in large electric generation, gasification, etc., projects that have been proposed.

TECHNICAL ISSUE NO. 20

The DES contains inaccurate or questionable economic-statistical projections or reference data.

Issue Raised By:

Environmental Impact Assessment Project
Environmental Impact Agency, State of New Mexico
Vickers Energy Corporation
Governor Link, State of North Dakota
Geological Survey
Environmental Protection Agency
Atomic Energy Commission

Response

Many of the statistics have been revised or updated from the draft.

The statistics represent what are believed to be the best available and are qualified as to the assumption, source, etc.

It would be relatively easy to find statistics that cite other coal reserves, quality, etc., but the new figure will not generally change the relative significance or overall potential. Further, it is not known which is the most reliable. Statistics available from reliable agencies of government are the most commonly cited.

TECHNICAL ISSUE NO. 21

The DES underestimates the reclamation potential of western coal lands.

Issue Raised By:

National Coal Association
Environmental Protection Agency

Response

The reclamation potential of western coal lands is discussed in the final impact statement using the best information available at the time it was written. We do not believe that the potential to successfully rehabilitate western coal lands was underestimated. We do, however, realize that the many environmental variables which dictate the success or failure of

rehabilitation efforts are site-specific and will be addressed in detail as subsequent mining plans and proposals are developed.

TECHNICAL ISSUE NO. 22

Rehabilitation of surface mined land is inadequately covered. Mitigating measures do not reflect probability of successful reclamation.

Issue Raised By:

Natural Resources Defense Council Inc.
Francis J. Walcott (Absarokee, Montana)
Public Services Co. of New Mexico
Larry Edwards (Rock Springs, Wyoming)
State of Texas
Lynne Bama (Wapita, Wyoming)
Amax Environmental Services Group
Bob Watt (Los Alamos, New Mexico)
Sierra Club
Environmental Impact Agency, State of New Mexico
Environmental Impact Assessment Project
National Park Service
New Mexico Citizens for Clean Air and Water
State of Montana

Response

The mitigating measures section portrays various ways or techniques to rehabilitate mined areas. The degree of success which can be expected from these mitigating measures are generalized in this statement. The many environmental variables which dictate the success or failure of rehabilitation efforts are (by their nature) site-specific and will be addressed in subsequent proposals on a site-specific basis.

TECHNICAL ISSUE NO. 23

The DES should reflect how detailed soil surveys would aid reclamation.

Issue Raised By:

Soil Conservation Service (Wyoming)
Geological Survey
Charles F. Metzger, North Dakota State Planning Division

Response

Chapter IV clearly states: "An intensive soil inventory of the area to be disturbed is required prior to any disturbance." This section adequately portrays the importance of soils in determining the methods to employ and expected results from land reclamation efforts.

TECHNICAL ISSUE NO. 24

Alternative Federal Leasing programs are inadequately considered.

Issue Raised By:

Natural Resources Defense Council, Incorporated
Council on Environmental Quality
Environmental Protection Agency
Wyoming Outdoor Council
Geothermal Energy Institute
West Virginia Legislative – Senate Mines and Mining Committee
Colorado Division of Planning
Council on Environmental Quality
Larry Edwards (Rock Springs, Wyoming)
Thomas E. Horobik (Great Falls, Montana)
Peabody Coal Company
Northern Plains Resource Council (Kit Muller)
Environmental Impact Assessment Project
Sierra Club
Donald C. Grey (Salt Lake City)

Response

The very broad nature and scope of this statement precludes a detailed environmental impact analysis of each possible leasing alternative. Alternative programs are thus respectively limited to general summary assessments of impacts which will result from a given leasing system. All leases are subject to reasonable and necessary surface use environmental stipulations, as such, it cannot be said that a new competitive leasing procedure is superior or inferior to another new procedure.

TECHNICAL ISSUE NO. 25

The DES fails to consider means of increasing energy conversion efficiency.

Issue Raised By:

North Dakota State Planning Division
Lynne Bama (Wapita, Wyoming)
North Dakota Wildlife Federation, Inc.
Environmental Impact Assessment Project
Sierra Club
State of Montana

Response

The substitutability and the various possibilities of increasing the efficiency of energy conversion are discussed in the alternatives section of the final statement. This discussion portrays both present technology and long range possibilities with predicted technological advances.

TECHNICAL ISSUE No. 26

The DES failed to properly consider geothermal steam as an alternative energy source.

Issue Raised By:

Geothermal Energy Institute

Response

The possibility of substituting other energy forms including geothermal steam for fossil energy forms is discussed in Chapter VIII of the final statement. It is beyond the scope of a programmatic statement to discuss each energy form in great detail or to make comparisons between the numerous energy sources. Other energy forms may or may not be viable alternatives to fossil energy (specifically coal) depending on geographic area, availability, cost, etc. These will be further considered on a site-specific basis as subsequent plans and proposals develop. Geothermal steam as an energy source is discussed in detail in the 1973 Geothermal Environmental Impact Statement.

Technical Issue No. 27

The DES fails to adequately discuss gasification.

Issue Raised By:

Natural Resources Defense Council, Incorporated

West Virginia Legislative – Senate Mines and Mining Committee
National Coal Association
Governor Link, State of North Dakota
Environmental Protection Agency

Response

The proposed action in this impact statement is the resumption of federal coal leasing. By the very nature of the proposed action and the scope of a programmatic statement, the many ultimate uses of coal must be considered in a general way. Depending on the time, place and existing technology coal gasification may or may not be a viable alternative to other uses of coal. Coal gasification must and will be considered on a site-specific basis as subsequent plans and proposals are developed. The possibility of substituting other energy forms including coal gasification is discussed in Chapter VIII of the final statement.

Technical Issue No. 28

The DES is deficient in addressing ancillary facilities of mine development.

Issue Raised By:

Sierra Club
Environmental Impact Assessment Project
Governor Link, State of North Dakota
Jack McNulty, Stanton, North Dakota
Atomic Energy Commission

Response

Both the draft and final statements discuss the need for a construction of facilities associated with a mining operation. The Department realizes that the associated facilities required vary significantly from area to area. The facilities needed for a mine operation also vary with the specific type of operation. The facilities needed to support a mining operation will be discussed and their impacts analyzed on an individual basis as coal development proposals are made.

TECHNICAL ISSUE NO. 29

The DES fails to cite steps to alleviate information gaps.

Issue Raised By:

Natural Resources Defense Council, Incorporated
Environmental Impact Assessment Project
Council on Environmental Quality
Environmental Protection Agency

Response

The Bureau's land use planning system upon which mineral leasing is based provides for identification of informational gaps within its inventory section. Accordingly, the district planning documents reflect these voids and make recommendations for alleviating information gaps. In cases where information is lacking about a critical resource, the decision to lease can be deferred until the missing data is available.

National Environmental Policy Act/Council Of Environmental Quality Issues

NEPA/CEQ ISSUE NO. 1

The format of the DES requires improvement to comply with CEQ guidelines.

Issue Raised By:

Natural Resources Defense Council, Inc.
Environmental Impact Assessment Project
Charles F. Metzger, North Dakota State Planning Division
Council on Environmental Quality
Environmental Protection Agency

Response

The statement format is in compliance with Departmental directives and manuals. The format has been utilized in numerous previous statements and is felt to be legally sufficient.

NEPA/CEQ ISSUE NO. 2

The DES has deviated from the Council on Environmental Quality guidelines requiring cost-benefit economic analysis.

Issue Raised By:

Arizona Public Services Company
Bureau of Mines
Colorado Division of Planning
Environmental Impact Assessment Project
National Coal Association
Council on Environmental Quality
State of Texas
Atomic Energy Commission

Response

The Department of the Interior will not prepare a cost/benefit analysis of this proposal in this statement. The Department of the Interior prefers not to utilize an environmental analysis as the decision-making document. Rather, it is designed to display the environmental costs of a proposal for consideration of the decision-maker. For this reason, cost-benefit justification data are not included in environmental analyses.

Accordingly, cost-benefit issues are reserved for inclusion in any subsequent Program Decision Option Document (PDOD). The PDOD identifies the environmental, economic, political, social, and resource developmental aspects of a proposal and its alternatives. Based upon the PDOD, the Department of the Interior will render a resource management decision.

NEPA/CEQ ISSUE NO. 3

The DES lacks detail required by NEPA.

Issue Raised By:

Lynne Bama (Wapita, Wyoming)
Environmental Impact Assessment Project
Donald C. Grey (Salt Lake City, Utah)
Council on Environmental Quality
Environmental Protection Agency

Response

The scope of the programmatic dictates that it provide an overview or broad coverage of the total leasing program. Since it is not site-specific, it cannot address immediate, local management issues. Rather it must focus on generalized types of impacts that result from exploration and mining

coupled with an assessment of the federal government's capability to either mitigate or correct them.

NEPA/CEQ ISSUE NO. 4

The DES should assess the cumulative impacts of leasing on all resources.

Issue Raised By:

Sierra Club
Environmental Impact Assessment Project
Environmental Protection Agency

Response

This statement does analyze the nationwide cumulative impacts of Federal coal leasing to the extent they are known or understood. We acknowledge that we cannot predict the exact level of development which will occur in the future, nor the resulting total environmental impacts. However, regional statements, such as the Eastern Powder River EIS are assessing regional cumulative impacts resulting from site-specific proposals.

NEPA/CEQ ISSUE No. 5

The Department of the Interior does not have authority to prepare the subject DES.

Issue Raised By:
Lynne Bama (Wapita, Wyoming)

Response

The National Environmental Policy Act directed the respective federal agencies to assess the environmental impacts of all their proposed actions and alternatives upon the human environment.

NEPA/CEQ ISSUE NO. 6

EMARS should not be the proposed Federal action but only an alternative to the resumption of Federal coal leasing.

Issue Raised By:

Peabody Coal Company
Rocky Mountain Coal Association

Response

It is the desire of the Department of the Interior in conformance with the Council on Environmental Quality guidelines that any proposed federal program or action be explicitly described. Resumption of leasing is but one step in meeting present and future nationwide energy demands. EMARS is only one component of a detailed leasing program. EMARS reflects the Department's desire for a leasing system that satisfies environmental constraints, determines location and timing, plus insures a fair market return from resources mined.

Program Policy Issues

PROGRAM POLICY ISSUE NO. 1

A clear, definitive federal coal leasing policy is needed.

Issue Raised By:

National Coal Association
Environmental Protection Agency
North American Coal Corporation

Response

This issue was recognized by the Secretary of Interior when he announced intentions on February 13, 1973, to develop a system to determine the size, timing and location of future coal leases to effectively meet energy needs. This leasing system developed is EMARS. Diligent development requirements, known coal leasing areas and advance royalty requirements presently proposed by the Department, are other building blocks in establishing a definitive federal coal leasing policy.

PROGRAM POLICY ISSUE NO. 2

The document raises issues that are beyond the scope of the proposed leasing program.

Issue Raised By:

Lynne Bama (Wapita, Wyoming)

Response

The document, by its very nature as a programmatic statement, attempts to provide a broad, environmental overview of the federal government's leasing program. As such it must, of necessity, encompass a broad range of related subjects and issues.

PROGRAM POLICY ISSUE NO. 3

The DES should clarify what the Department of the Interior environmental assessment policy will be relative to future leasing and development.

Issue Raised By:

Environmental Impact Assessment Project
Governor Link, State of North Dakota

Response

Guidance to be followed by agencies of the Department of the Interior for environmental assessment of future leasing and development proposals can be found in the Department of the Interior Manual 516.1, .2, and 30 CFR 211; and BLM Manuals 1790, 1791, and 1792, and 43 CFR 23; and in Chapter 1 of this statement.

PROGRAM POLICY ISSUE NO. 4

The proposed leasing program fails to fully address nationwide energy conservation.

Issue Raised By:

Natural Resources Defense Council, Incorporated
North Dakota State Planning Division
Larry Edwards (Rock Springs, Wyoming)
Environmental Impact Agency, State of New Mexico
Lynne Bama (Wapita, Wyoming)
Environmental Impact Assessment Project
Environmental Protection Agency

Response

The alternative "Energy Conservation" has been updated to include data not available at the time the draft statement was published. Some of the documents utilized in developing this alternative were: Ford Foundation Studies, Project Independence Bulletin, and the Council on Environmental Quality's "Half and Half Energy Plan."

PROGRAM POLICY ISSUE NO. 5

The DES fails to relate the proposed federal leasing program to the national energy policy.

Issue Raised By:

Colorado Division of Planning
Council on Environmental Quality
Carter Oil Company
National Coal Association
Northern Plains Resource Council (Kit Muller)
Environmental Impact Assessment Project
Governor Link, State of North Dakota
Council on Environmental Quality
Environmental Protection Agency
State of Texas
North American Coal Corporation

Response

The final statement discusses the projected energy requirements for the United States based upon the Project Independence Blueprint. A great deal of background information leading up to these projections is also given in this document.

This is a transitional period in the development of energy policy in the United States. The government is seeking a central course among available options that will best serve the needs of the Nation. The overall goal is to furnish the administrative and economic climate under which industry can provide energy supplies in adequate amounts at reasonable costs with minimum environmental degradation. To achieve this end, President Nixon, in his Clean Energy Message to Congress of June 14, 1972, detailed a program to insure an adequate supply of clean energy.

That program contained the following elements:

1. Facilitate research and development for clean energy.
2. Make available the energy resources on federal lands.
3. Assure a timely supply of nuclear fuels.
4. Use energy more wisely.
5. Balance environmental and energy needs.
6. Organize federal efforts more wisely.

The department believes that this statement is consistent with and enhances the broad energy policy outlined above.

In addition, the proposed leasing program provides the flexibility necessary to respond to any eventual policy which may be forthcoming from the Project Independence efforts presently underway.

PROGRAM POLICY ISSUE NO. 6

Federal coal should not be leased when federal leases and privately owned coal are still undeveloped.

Issue Raised By:

North Dakota State Planning Division
Environmental Impact Assessment Project
Governor Link, State of North Dakota
Bruce Hagen, North Dakota Public Service Commission
Terance Lamb, United Plainsmen Association
Environmental Protection Agency

Response

The Federal Government has significant acreages of coal under lease and the majority of these leases are not under production at this time.

In many instances neither privately-owned nor Federally-leased coal lands are available individually or in the proper mix to make an efficient mining unit. Thus, not leasing in some areas could result in greater adverse impacts over larger areas than would occur if certain Federal leases were approved.

The Bureau of Land Management's 1974 study[1] indicates existing leases may not be adequate to meet the Nation's energy needs and that a flexible leasing program is necessary if one is concerned about the overall environmental and social impacts of energy supply and cost to the public.

[1]Analysis of Federal Coal Leases and Their Adequacy for Near Future Production, Department of Interior, Bureau of Land Management, 1974.

PROGRAM POLICY ISSUE NO. 7

The document fails to justify resumption of leasing based upon present acreages under lease.

Issue Raised By:

Wyoming Outdoor Council
Powder River Basin Resource Council
Environmental Protection Agency
North Dakota Wildlife Federation, Incorporated
North Dakota State Planning Division
Council on Environmental Quality
Thomas E. Horobik (Great Falls, Montana)
Environmental Defense Fund – Katherine Fletcher
Colorado Open Space Council
Tim Johnson
Northern Plains Resource Council (Kit Muller)
Northern Plains Resource Council (Robert Tulley)
Tri-County Ranchers Association
Iowa Confederation of Environmental Organizations
Environmental Impact Assessment Project
Pat Ford (Idaho Falls, Idaho)
State of Montana (Bill Christianson)
Governor Link, State of North Dakota
Bruce Hagen, North Dakota Public Service Commission
Terance Lamb, United Plainsmen Association

Response

An EIS is not to justify a proposal but to present facts to be used in the decision-making process. See Program Policy Issue No. 6 for further information on present acreages under lease.

PROGRAM POLICY ISSUE NO. 8

The proposed federal coal leasing program should not adopt a priority leasing criteria based upon "highest quality" and "least cost of production."

Issue Raised By:

National Coal Association
North American Coal Corporation

Response

The proposed Federal Coal Leasing Program (EMARS) does not base its tract selection process on highest qual-

ity and least cost of production, but, utilizes coal quality and quantity; recommendations from the public and an impact analysis based on environmental, social, and economic impacts of the region and the nation.

PROGRAM POLICY ISSUE NO. 9

The proposed federal leasing program has failed to reflect a governmental policy relative to maximum recovery and utilization of coal.

Issue Raised By:

Northern Plains Resource Council (Kit Muller)
Iowa Confederation of Environmental Organizations
Environmental Impact Assessment Project
National Coal Association
North American Coal Corporation

Response

It is Departmental policy to maximize resource recovery so as to minimize the need for future reentry.

The Secretary of the Interior has delegated to the Regional Mining Supervisor, G.S., to review, modify and approve proposed mining plans, as well as the responsibility to see that stipulations in the mining plan are carried out. At this time there is no written guidance describing a process to follow in determining maximum recovery to be included in mining plans. Recovery is now being determined on a case by case basis by the Area Mining Supervisor.

The Geologic Survey is now in the process of writing manualized instruction to be followed in determining coal recovery and conservation mining plan stipulations.

PROGRAM POLICY ISSUE NO. 10

The proposed leasing program inadequately considers total resource values and long term/short term costs.

Issue Raised By:

Arizona Wildlife Federation
Francis J. Walcott (Absarokee, Montana)
Lynne Bama (Wapita, Wyoming)
Ellen Pfister Withers (Billings, Montana)
Amax Environmental Services Group
Kerr-McGee Corporation
Environmental Impact Assessment Project
Environmenal Protection Agency
North American Coal Corporation
Sandia Mountain Wildlife and Conservation Association
Pat Ford (Idaho Falls, Idaho)
Gulf Mineral Resources Company
State of Montana (Bill Christianson)
Governor Link, State of North Dakota

Response

Chapter VI of the statement explores the relationship of federal coal leasing to long-term productivity and management of the land. This section assesses in a general nature long-term productivity versus short-term gains. Development of non-renewable resources such as coal requires a trade-off on the long-term productivity of the renewable multiple uses.

Predicting renewable resource values over time is very difficult but economic evaluations often show that when utilizing present day discount factors, the present value of mineral resources often exceeds that of other uses. The actual comparisons must be made, however, on an individual basis considering specific proposals.

This is not to say that the policy of federal land managers is to always go with the evidently greater economic gain. Land managers more properly operate under multiple use principles to accommodate all legitimate uses, though not necessarily on the same land at the same time, for the good of all interests.

It is the judgment of many land managers that under the multiple-use concept mining is a legitimate land use along with grazing, farming, recreation, wildlife, etc. In the process of developing a multiple-use plan, all resources are evaluated and land units may be located where mining can be accommodated. In the multiple-use planning process the short-term mining use is evaluated against the long-term impacts on the total ecosystem.

PROGRAM POLICY ISSUE NO. 11

The proposed leasing program creates excessive governmental regulations.

Issue Raised By:

Mountain States Resources Corporation

Response

The proposed leasing program is essentially functional within existing regulations.

PROGRAM POLICY ISSUE NO. 12

The proposed leasing program should provide for state and public participation in tract selection.

Issue Raised By:

Mineral Exploration Company
Senator Frank E. Moss (Utah)
Utah Geological and Mineral Survey
Environmental Impact Assessment Project
American Mining Congress
Pat Ford (Idaho Falls, Idaho)
National Coal Association
Governor Link, State of North Dakota

Response

An important aspect of the EMARS program will be input to the program by all parties of interest. Leasing alternatives will be considered through the Bureau of Land Management's comprehensive land use planning offering the opportunity for participation. The environmental assessment will offer further opportunity for involvement. Federal Register Notice will call for public nomination of coal leasing tracts.

Due to the intermingled ownership of state and federal land, in some states, close coordinating procedures will be needed. These procedures will be developed as the program moves into operation. State and local planning where it exists will be recognized in the federal coal leasing program.

PROGRAM POLICY ISSUE NO. 13

The proposed federal coal leasing program must reflect mineral development compliance with individual state regulations and programs.

Issue Raised By:

Environmental Impact Agency, State of New Mexico

Environmental Impact Assessment Project
Governor Link, State of North Dakota

Response

As stated previously, this policy is to be addressed in future rulemaking with respect to reclamation.

PROGRAM POLICY ISSUE NO. 14

The federal coal leasing program should reflect industry and public tract selection nominations.

Issue Raised By:

Carter Oil Company
Kerr-McGee Corporation
Environmental Impact Assessment Project
National Coal Association
Governor Link, State of North Dakota
North American Coal Corporation

Response

This is an integral facet of the proposed leasing program. Procedures are described in greater detail in the final statement than those cited within the draft.

PROGRAM POLICY ISSUE NO. 15

The proposed leasing program fails to provide for the small operator.

Issue Raised By:

Mineral Exploration Company
Utah Resources International, Incorporated
James Goodwin (Denver, Colorado)
Donald C. Grey (Salt Lake City, Utah)
North American Coal Corporation
Gulf Mineral Resources Company

Response

Various Federal programs can help to provide relief for small business. Some of these programs are: (1) the short-term leasing criteria of the Department of the Interior which provides for coal leases to ongoing business running short of coal reserves; (2) limitation of tract size or location of tract could limit sales to small operators; and (3) the Small Business Administration's program which provides for "set aside sales" which limit the size of the company qualified to bid on these competitive sales.

PROGRAM POLICY ISSUE NO. 16

The proposed federal coal leasing program fails to provide for non-governmental prospecting and exploration.

Issue Raised By:

Arizona Public Services Company
American Electric Power Service Corporation
Utah Resources International, Incorporated
Utah Power and Light Company
Kerr-McGee Corporation

Response

The proposed Federal Coal Leasing Program does include provisions by which private industry can participate jointly in the prospecting of coal areas where sufficient information is not available for lease evaluation. The program is discussed in Section I. Proposed rule-making will offer the opportunity for an interested company to gain information for evaluating prospective lease offers.

The traditional prospecting permit program lacked control as to where, when and how much will be prospected. The proposed program will direct a specific prospecting program necessary for the proper evaluation of the quantity and quality of the coal resource.

At least for the near term, the moratorium on issuance of new prospecting permits will be continued to gain experience with the leasing program.

PROGRAM POLICY ISSUE NO. 17

The DES must be expanded to reflect the prospecting-testing aspect of the proposed federal coal leasing program.

Issue Raised By:

Donald C. Grey, Salt Lake City, Utah
Utah Power and Light Company

Response

The expanded description of the proposed leasing program in Chapter I of the statement covers proposed prospecting-testing procedures.

PROGRAM POLICY ISSUE NO. 18

The document must be expanded to include and describe administrative management proposals for the existing prospecting permit-preference right lease program.

Issue Raised By:

Peabody Coal Company
Darrell Skelton (Wheat Ridge, Colorado)
Utah Power and Light Company
Kerr-McGee Corporation
Sierra Club
Environmental Impact Assessment Project
American Mining Congress
National Coal Association
Environmental Protection Agency

Response

The document has been revised to better explain the federal policy relative to existing prospecting permits.

PROGRAM POLICY ISSUE NO. 19

Future federal coal leasing should be limited to resumption of the prospecting permit/preference right lease system.

Issue Raised By:

Peabody Coal Company
National Coal Association
Rocky Mountain Coal Association

Response

A wholesale resumption of the Prospecting Permit/Preference Right Lease System could lead to a "coal rush" to tie up valuable energy resource. Anyone with financing could gamble on prospecting to receive the rights to a coal deposit. The net result of such a system could result in greater environmental degradation, greater speculation in the industry, higher prices to the consumer and no greater supply of coal on the market.

A planned Federal Coal Program would serve to lessen all above-mentioned impacts.

PROGRAM POLICY ISSUE NO. 20

Federal development of coal is an undesirable alternative for the proposed coal leasing program.

Issue Raised By:

Carter Oil Company
Utah Mining Association
Kerr-McGee Corporation
American Mining Congress
National Coal Association

Response

Federal development of coal is mentioned as an alternative to the proposed action. No legislation exists to allow this type of involvement and the current policy is to foster and encourage private development.

PROGRAM POLICY ISSUE NO. 21

The proposed federal coal leasing program should be designed to discourage speculation by:

a. Providing for advance royalty bidding.
b. Requiring lessee to show ability and intent to mine.
c. Utilizing a percentage (20 year) royalty.
d. Restricting lease assignments.
e. Allowing for utilization of leases.

Issue Raised By:

Peabody Coal Company
North American Coal Corporation

Response

All aspects of the above proposal are currently being given consideration by the Department.

PROGRAM POLICY ISSUE NO. 22

Competitive, bonus bidding for coal leases contains inequities.

Issue Raised By:

Utah Power and Light Company
James Goodwin (Denver, Colorado)
Northern Cheyenne Tribe
Environmental Impact Assessment Project
Mountain States Resources Corporation
Gulf Mineral Resources Company

Response

One objective of the future federal coal leasing program is that it provide a fair market return in revenues and royalties to the American public. The Department is proposing to let the marketplace determine future revenues for federal coal. The Department is also exploring competitive lease procedures that will allow a small developer the capability of bidding against large, financially strong operations.

PROGRAM POLICY ISSUE NO. 23

The proposed federal leasing program should include diligence requirements to discourage speculative leasing.

Issue Raised By:

C. P. Heiner and Company, Incorporated
National Coal Association
Peabody Coal Company

Response

The Department of Interior is proposing that the old preference right lease system and the new lease program include specific diligence requirements as previously described in Chapter One.

PROGRAM POLICY ISSUE NO. 24

The relationships of private surface over federal minerals should be discussed in the environmental statement.

Issue Raised By:

Northern Plains Resource Council (Kit Muller)
Environmental Impact Assessment Project
R. G. Sailer, North Dakota Rancher

Response

The original patent which passed title of the land from the Federal Government to the private individual reserved the minerals to the people of the United States and provided for the right of ingress and egress, to explore for and extract the minerals. It also provided for the use of as much land surface as necessary to conduct the mining operation and required the mineral lessee to post a bond to cover surface damages.

The Bureau of Land Management's Manual Release, Section 3509, describes the steps to be taken in conducting a Part 23 Technical Field Examination prior to making a decision of whether or not to issue a mineral lease. It states that an interdisciplinary team is to be established to conduct the field examination, that the surface owner must be contacted and provided the opportunity to make recommendations for stipulation to be included in the mineral lease and the reclamation plan. One bond is required for lease compliance to insure that reclamation requirements are fulfilled.

PROGRAM POLICY ISSUE NO. 25

The proposed federal coal leasing program must insure competitive, non-discriminating leasing.

Issue Raised By:

National Coal Association

Response

Equitable, competitive leasing procedures designed to return a fair market value to the federal government are a major policy objective of the proposed leasing program.

PROGRAM POLICY ISSUE NO. 26

The DES failed to reflect a justification for changing the prospecting permit/preference right least system.

Issue Raised By:

Donald C. Grey, Salt Lake City, Utah
Utah Power and Light Company
Governor Link, State of North Dakota

Response

The final environmental statement contains a summary of data compiled by the Bureau of Land Management in its 1974 study, *An Analysis of Federal Coal Leases and Reserve Adequacy for Near Future Needs.*

This study statistically reflected developmental problems associated with the prospecting permit/preference

right lease system. Conclusions reached upon review of this information contributed to the Departmental decision to propose a new energy oriented leasing program.

PROGRAM POLICY ISSUE NO. 27

The proposed federal coal leasing program must insure availability of adequate inventory data prior to competitive leasing.

Issue Raised By:

Utah Power and Light Company
Atlantic Richfield Company
Environmental Impact Assessment Project
Governor Link, State of North Dakota
North American Coal Corporation

Response

One major concept being considered by the Department of the Interior at this time is that individual testing be authorized for all interested parties for a given period of time prior to competitive leasing. Another proposal. which has been suggested, is that the government fund testing and then make the information available to all interested parties.

PROGRAM POLICY ISSUE NO. 28

The DES should reflect the beneficial environmental aspects of underground mining versus strip mining.

Issue Raised By:

Northern Plains Resource Council (Robert Tulley) Billings Hearing
Environmental Impact Assessment Project

Response

The function of the statement is to identify environmental impacts that result from both types of operation.

PROGRAM POLICY ISSUE NO. 29

The Department of the Interior should create a prototype coal strip mine reclamation project prior to resuming leasing. This project should be similar in scope to the oil shale prototype efforts.

Issue Raised By:

Natural Resources Defense, Incorporated

Response

The prototype oil shale program was a limited program designed to develop the technology for eventual future leasing and finally commercial production of oil from oil shale. Reclamation research for revegetation of spent oil shale is being conducted in only one State, Colorado, whereas mined-land reclamation research has been going on for a number of years, in many States, on a variety of soil types and under a variation of climatic conditions. This research is being carried out by universities, Federal and State agencies and private groups. Due to the extensiveness and variety in coal reclamation research programs, the results should provide more useful data than an oil shale prototype type research program.

PROGRAM POLICY ISSUE NO. 30

The ability of the government to base the proposed leasing program on sound economic predictions of nationwide energy needs is questioned.

Issue Raised By:

James Goodwin (Denver, Colorado) Denver Hearing
Utah Mining Association
Carter Oil Company
National Coal Association
Environmental Impact Assessment Project
American Mining Congress
Gulf Mineral Resources Company
Environmental Protection Agency
North American Coal Corporation

Response

The government's economic predictions of nationwide coal needs will not be the sole factor used to decide where, when and how much coal reserve to lease. Expressed needs and desires of the coal industry through nomination procedures, coal consumers, local governments and the public will be weighed prior to final leasing decisions.

In addition, the government's predictions will be open for review by non-government experts and others prior to leasing actions. These economic predictions are largely used by the federal agencies, particularly the Bureau of Land Management, to allocate their manpower and available resources to the large planning task involved in the new coal program. It is not the intent of the new program to rely solely on these predictions to establish fixed acreages for lease, but merely to give guidance, through planning, to federal agencies responsible for selecting lease sites.

PROGRAM POLICY ISSUE NO. 31

The DES fails to properly portray economic coal interrelationship in the energy mix.

Issue Raised By:

Kerr-McGee Corporation
Environmental Impact Assessment Project
Governor Link, State of North Dakota
Council on Environmental Quality
Environmental Protection Agency

Response

Escalating oil prices significantly altered much of the economic data and projections found in the draft document. This information has been corrected and updated in the final statement. Unfortunately, statistics in a statement of this kind are current only as of the moment the document was written.

PROGRAM POLICY ISSUE NO. 32

The proposed federal coal leasing program detracts from the American free market system.

Issue Raised By:

Exxon Company – USA
El Paso Natural Gas Company
Chamber of Commerce of the United States
Carter Oil Company
American Electric Power Service Corporation
Amax Coal Company
John S. Wold Minerals
Major Briggs
James Goodwin, Denver, Colorado
Darrell Skelton, Wheatridge, Colorado
Kerr-McGee Corporation

National Coal Association
American Mining Congress
Mountain States Resources Corporation

Response

The proposed coal leasing program is not a departure from the traditional American free market system. The new leasing program will reduce the opportunities for windfall profits by speculators and change the historical method of automatic issuance of permits and leases on all lands requested by an applicant. The new program will control the amount of leasing, but it does not detract from free market competition of bidding on individual leases. The number of leases offered will be limited only by national and regional demand for coal. Leases will be offered at the time the resource is needed considering a normal development period to get into production.

In the long run the proposed program should help to maintain an even flow of coal to the market place, contribute to a steady market price and reduce the cost of energy to the consumer by eliminating monopolistic practices where holders of large blocks of energy resources can restrict the supply, thus, drive up the market price.

PROGRAM POLICY ISSUE NO. 33

The DES fails to assess the impact of competitive leasing on coal prices.

Issue Raised By:

Public Services Company of New Mexico

Response

As in most competitive bid situations, bids will be determined by using: 1. Current market price, 2. Desired profit margin, 3. Operating costs, 4. Depreciation of capital goods, and 5. Future market price and demand expectations. Thus, supply and demand will determine the bid price, just as supply and demand now regulate the sale price of coal. Therefore, competitive bidding on coal leases will have only minimal impact on coal prices.

PROGRAM POLICY ISSUE NO. 34

The proposed Federal Coal Leasing Program is inadequate to allow proper industrial financing, development and long-range planning.

Issue Raised By:

Arizona Public Services Company
Carter Oil Company
Utah Mining Association
Utah Power and Light Company
National Coal Association
Getty Oil Company
American Mining Congress
National Coal Association
Peabody Coal Company
Utah Power and Light Company
Rocky Mountain Coal Association
North American Coal Corporation

Response

The intent of the federal coal leasing program is to offer coal leases at the time the coal will be needed in the market, considering a normal planning and development period. An advance period of from three to five years of actual need is anticipated. It is the government's position that in normal circumstances this advance time is sufficient for planning, arranging, financing and developing facilities for production.

Environmental studies and analyses will have been completed for the lease consideration prior to the lease role so major delays are not anticipated. Environmental studies and statements concerning coal utilization in electric generation or gasification plant, will have to progress with coal consideration to avoid delays.

The proposed federal coal leasing program will have greater limitations than those of the past, but it should not create undue hardship for a company with experience and knowledge to plan, finance, and develop a project.

PROGRAM POLICY ISSUE NO. 35

The proposed coal leasing program fails to assess the impact of new western development upon the existing eastern coal industry.

Issue Raised By:

West Virginia Legislative – Senate Mines and Mining Committee
Council on Environmental Quality
Lynne Bama, Wapita, Wyoming
City of Charleston, West Virginia
Environmental Impact Assessment Project
Pat Ford, Idaho Falls, Idaho
Council on Environmental Quality
Environmental Protection Agency

Response

A new section under Energy Alternatives discusses development of non-federal coal reserves rather than leasing additional federal coal lands. Non-federal western coal as well as eastern coal is available and both these sources are covered in the new section.

PROGRAM POLICY ISSUE NO. 36

Changes in the Government's coal leasing policy should be through notice in the *Federal Register* and provide for public review.

Issue Raised By:

Peabody Coal Company

Response

Most of the elements of the proposed program will be adopted through the rule-making process; the proposed rules will be printed in the *Federal Register* and will be the subject of public review and comment.

PROGRAM POLICY ISSUE NO. 37

Authority for establishing federal mineral leasing policy should rest with Congress and not the Secretary of the Interior.

Issue Raised By:

North Dakota Wildlife Federation, Incorporated
Philip Kernan, Jr., Boulder, Colorado
James Goodwin, Denver, Colorado
Northern Plains Resource Council (Robert Tulley)
State of Montana (Bill Christianson)

Response

The Federal Mineral Leasing Act, as amended, was written and passed by the Congress of the United States. Within this Act, Congress set the broad Federal leasing policy and the parameters within which their agent could

lease. In the Act, Congress selected the Secretary of the Interior as their agent to administer the law and delegated to him the responsibility to develop the leasing regulations, within the scope set by the Act, needed to carry out leasing of Federal minerals. As a result, the Secretary of the Interior does set policy but this policy is within the scope set by the Act.

PROGRAM POLICY ISSUE NO. 38

Future coal leasing should provide for maximum wildlife habitat protection.

Issue Raised By:

Arizona Wildlife Federation
North Dakota Wildlife Federation, Incorporated
Sierra Club

Response

Chapter IV (f) discusses many mitigating measures designed to protect and enhance wildlife habitat. Examples of lease stipulations (Appendix G) provide for a minimum of wildlife habitat disturbance or destruction. Many coal producing areas have unique wildlife habitat problems. These areas will require individual assessments with resulting lease stipulations designed to mitigate adverse effects on wildlife habitat.

To insure that optimum mitigating measures are considered for the protection or enhancement of wildlife and wildlife habitat, wildlife specialists will be a member of the interdisciplinary team evaluating each proposed lease.

PROGRAM POLICY ISSUE NO. 39

The proposed leasing program should not allow for strip mining until industry proves that the environment can be protected.

Issue Raised By:

Lynne Bama, Wapita, Wyoming
Arizona Office of Economic Planning and Development
Colorado Division of Planning
Environmental Impact Assessment Project
Governor Link, State of North Dakota
Bruce Hagen, North Dakota Public Service Commission
Terance Lamb, United Plainsmen Association
William R. VanDosting, North Dakota Rancher

Response

Many experimental research rehabilitation projects are now being conducted throughout the United States by Federal, State, and private organizations. Partial results of these studies are available and being incorporated into the reclamation plans of ongoing leases as well as new leases. This current data indicates that rehabilitation of mined lands can be accomplished with sound preliminary planning. However, in those instances where the preplanning indicates that, with the present state of the art, rehabilitation cannot be accomplished the final decision may be not to disturb the surface.

PROGRAM POLICY ISSUE NO. 40

The DES reflects inadequate resource/land use data relative to the Northern Great Plains.

Issue Raised By:

Lynne Bama, Wapita, Wyoming
Ellen Pfister Withers, Billings, Montana
Governor Link, State of North Dakota
Charles F. Metzger, North Dakota State Planning Division
Terance Lamb, United Plainsmen Association
Environmental Protection Agency

Response

A programmatic level EIS is necessarily broad in scope and resource data tends to be quite general. Additional data will be provided in other EIS's dealing with NGP area, such as the Eastern Powder River EIS.

PROGRAM POLICY ISSUE NO. 41

Future leases should contain stipulations to also insure off-site environmental protection.

Issue Raised By:

Sierra Club
Environmental Impact Assessment Project

Response

The Department of the Interior will continue to impose stipulations for any mineral development that are reasonable, necessary, and legal. This includes measures to protect against both on- and off-site environmental effects.

PROGRAM POLICY ISSUE NO. 42

Future coal leasing should first be assessed on a regional basis.

Issue Raised By:

Mrs. Dwaine (Amy) Clemens, Delta, Colorado
Herrick Roth, Denver, Colorado
Iowa Confederation of Environmental Organizations
Environmental Impact Assessment Project
Governor Link, State of North Dakota
Charles F. Metzger, North Dakota State Planning Division
Council on Environmental Quality
Environmental Protection Agency

Response

The Department of the Interior will make the maximum effort to ensure that future major leasing programs are based upon sound land-use planning.

PROGRAM POLICY ISSUE NO. 43

Croplands should not be leased for strip mining.

Issue Raised By:

North Dakota Wildlife Federation, Incorporated
Lynne Bama, Wapita, Wyoming
Northern Plains Resource Council
Pat Ford, Idaho Falls, Idaho
Terance Lamb, United Plainsmen Association

Response

The Proposed Leasing Program adequately considers total resource value and long-term/short-term cost in relevance to this issue. Croplands offer both advantages and disadvantages when considering leasing and sub-

sequent development. Due to their greater productivity, losses during the interruption period will be greater than on grazing lands. The relative importance of these dryland crop areas has shifted in recent years. During the 1950s and 1960s large acreages were set aside for conservation uses and establishment of permanent grass cover. The 1970s has seen a shift to large exports of grains and elimination of set-aside programs to get maximum acreage under production. Cropland areas are therefore, today, relatively more important for keeping in production.

Advantages for leasing and subsequent development are that these croplands are in more favorable precipitation areas and soils are deeper and more fertile. These factors make it easier to properly mine the coal and rehabilitate the surface. Recovery of surface productivity is more rapid with less chance of failure.

The consideration of whether to lease in a cropland area must be made on an individual basis after considering all factors. Flexibility to consider leasing of coal under croplands is necessary for overall management of the Coal Program. Maximum efforts in rehabilitation will insure minimum interruption and restoration to croplands of equal or better uses when mining is complete.

PROGRAM POLICY ISSUE NO. 44

The Department should not establish a leasing program until it finalizes a pending coal leasing policy option study.

Issue Raised By:

Environmental Protection Agency

Response

Preparation of a Program Decision Option Document (PDOD) is the final administrative procedure within the Departmental decision-making process. This document reflects the collective environmental, economic, social-political, and resource developmental potentials and impacts of a proposed Federal action and its alternatives. The coal leasing policy option study is a framework for the PDOD.

Legislative Issues

The following five points were raised by individuals or groups while commenting on the DES.

LEGISLATIVE ISSUE NO. 1

Reclamation requirements for coal leasing should be backed by statute.

Issue Raised By:

North Dakota Wildlife Federation, Incorporated
John S. Wold Minerals
Colorado Open Space Council
New Mexico Citizens for Clean Air and Water

Response

Legislation is presently being considered by Congress and if such legislation is enacted, all Federal leases will be processed and developed in compliance with the enacted law. The Department has the authority, under present statutes, to adopt the proposed program, including those aspects relating to reclamation.

LEGISLATIVE ISSUE NO. 2

The proposed leasing program should address compensation for owners of surface lands when federal minerals are being mined.

Issue Raised By:

North Dakota State Planning Division
Walter Bales (Otter, Montana)
Charles F. Conley (Otter, Montana)
Environmental Impact Assessment Project

Response

This issue can only be resolved through legislation. Legislation is presently being considered by Congress to address the problem of surface rights versus subsurface mineral rights and arrive at an equitable solution.

LEGISLATIVE ISSUE NO. 3

The proposed leasing program should prohibit leasing when the surface is in private ownership.

Issue Raised By:

West Virginia Legislative – Senate Mines and Mining Committee
Francis J. Walcott (Absarokee, Montana)
City of Charleston (West Virginia)

Response

Existing legislation provides for the leasing of Federal minerals which occur under private surface lands. Congress is presently considering the enactment of legislation which may resolve this issue either through a prohibition, as suggested, or through a means to compensate owners for the use of surface lands.

LEGISLATIVE ISSUE NO. 4

Preparation of a coal leasing EIS is premature in light of existing mining legislation before Congress.

Issue Raised By:

Chamber of Commerce of the United States
Environmental Defense Fund – Katherine Fletcher
Environmental Impact Assessment Project
Norman C. Rolfson, Isaac Walton League
Bruce Hagen, North Dakota Public Service Commission

Response

There is no assurance that proposed legislation now being considered by Congress will be enacted. The Department does not believe that waiting until all final legislative actions are concluded will best serve the public interest. Upon enactment of any mining legislation Departmental policies will be modified to meet the Congressional mandates enunciated.

LEGISLATIVE ISSUE NO. 5

Pollution control should be vested in the courts.

Issue Raised By:

Mountain States Resources Corporation

Response

It is the policy that environmental standards should be set in the first instance by administrative agencies with special expertise in the area. Federal and state laws

pertaining to pollution control provide criteria and standards which must be adhered to in any development. Mining operations based on Federal leases must conform to the established standards. Any litigation which ultimately arises out of the enforcement of this legislation can be taken through the courts.

Review Record

The foregoing paragraph identified the issues raised, who raised the issue, and provides a response to the specific issue. Therefore, the written comments received are not included as an appendix to this statement. However, all written comments and statements received in review of the draft environmental impact statement have been indexed and are on file and available for public review at:

Bureau of Land Management (731)
Department of the Interior
Washington, D.C. 20240

Following is a listing of all respondents to the environmental impact statement.

1. State of Washington
2. Bob Watt (Los Alamos, New Mexico)
3. New Mexico Citizens for Clean Air and Water
4. Museum of Northern Arizona
5. Natural Resources Defense Council, Incorporated
6. Geothermal Energy Institute
7. Mrs. Dwaine (Amy) Clemens (Delta, Colorado)
8. Sandia Mountain Wildlife and Conservation Association
9. Philip Kernan, Jr. (Boulder, Colorado)
10. Vickers Energy Corporation
11. North Dakota State Planning Division
12. Carter Oil Company
13. U.S. Department of Agriculture, Soil Conservation Service (Wyoming)
14. Geological Survey of Wyoming
15. Francis J. Walcott (Absarokee, Montana)
16. Lynne Bama (Wapita, Wyoming)
17. Arizona Office of Economic Planning and Development
18. Thomas E. Horobik (Great Falls, Montana)
19. Utah Environment Center
20. Ellen Pfister Withers (Billings, Montana)
21. Exxon Company – USA
22. El Paso Natural Gas Company
23. Arizona Wildlife Federation
24. West Virginia Legislative – Senate Mines and Mining Committee
25. Kerr-McGee Corporation
26. City of Charleston (West Virginia)
27. Burlington Northern
28. Society of Vertebrate Paleontology
29. North Dakota State Planning Division
30. Public Services Company of New Mexico
31. Mr. and Mrs. E. M. Kivver (Forsyth, Montana)
32. Larry Edwards (Rock Springs, Wyoming)
33. Arizona Public Services Company
34. Wyoming Outdoor Council
35. Environmental Impact Agency, State of New Mexico
36. National Park Service
37. U.S. Department of Agriculture, Soil Conservation Service (Washington)
38. North Dakota Wildlife Federation, Incorporated
39. Bureau of Outdoor Recreation
40. BP North America, Incorporated
41. Powder River Basin Resource Council
42. Colorado River Board of California
43. State of Alaska
44. Getty Oil Company
45. Council on Environmental Quality
46. Bureau of Mines
47. Tennessee Valley Authority
48. Natural Resources Defense Council, Incorporated
49. American Mining Congress
50. Colorado Division of Planning
51. Chamber of Commerce of the United States
52. C. P. Heiner and Company, Incorporated
53. Mountain States Resources Corporation
54. National Coal Association
55. Atlantic Richfield Company
56. Sierra Club
57. Utah Power and Light Company
58. Environmental Impact Assessment Project
59. American Electric Power Service Corporation
60. Mineral Exploration Company
61. Amax Coal Company
62. John S. Wold (Wyoming)
63. Major J. C. Briggs (Wyoming)
64. Lt. Governor; State of Montana
65. Raymond L. Gold (Montana)
66. Northern Cheyenne Tribe
67. Walter Bales (Otter, Montana)
68. Charles F. Conley (Otter, Montana)
69. Northern Plains Resource Council (Kit Muller)
70. Northern Plains Resource Council (Robert Tulley)
71. Tri-County Ranchers Association
72. Rosebud Protective Association
73. Iowa Confederation of Environmental Organizations
74. Northern Plains Resource Council (Jean Hjermsted)
75. Environmental Defense Fund – Katherine Fletcher
76. Peabody Coal Company
77. Colorado Open Space Council
78. Carter Oil Company
79. James Goodwin (Denver, Colorado)
80. Darrell Skelton (Wheat Ridge, Colorado)
81. Amax Environmental Services Group
82. Michael Gansecki (Boulder, Colorado)
83. Tim Johnson (Colorado)
84. Herrick Roth (Denver, Colorado)
85. Ms. Dolly Plum representing Sen. Frank E. Moss
86. Utah Geological and Mineral Survey
87. Utah Resources International, Incorporated
88. Geological Survey
89. Utah Mining Association
90. Pat Ford (Idaho Falls, Idaho)
91. Pennsylvania Department of Environmental Resources
92. Donald C. Grey (Salt Lake City, Utah)
93. Gulf Mineral Resources Company
94. Bureau of Mines, Alaska
95. Isaac Walton League
96. Governor Link, State of North Dakota
97. North Dakota Public Service Commission

98. Jack McNulty (Stanton, North Dakota)
99. United Plainsmen Association
100. William R. Van Oosting (North Dakota)
101. R. G. Sailer (North Dakota)
102. U.S. Department of Agriculture, Forest Service
103. Environmental Protection Agency
104. Bureau of Reclamation
105. State of Texas
106. Rocky Mountain Coal Association
107. Fish and Wildlife Service
108. North American Coal Corporation
109. Atomic Energy Commission

United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
L7619-MQ

JUL 1 1974

Memorandum

To: Director, Bureau of Land Management

Through: Assistant Secretary for Fish and Wildlife and Parks

From: Acting Associate Director, Park System Management

Subject: Review of BLM Draft Environmental Statement on Proposed Federal Coal Leasing (DES 74-53)

This is in response to your request for comments on the above subject statement.

We find the broad, summary approach to the description of the cultural (historic, archeological, architectural) resources generally appropriate to the nature of the subject. However, only the description accorded the cultural resources of the "Rocky Mountains Province" is sufficiently informative. We recommend that the descriptions of the other provinces be expanded to a comparable state of completeness and analysis.

Although the nature of the discussion is necessarily problematic, we do not believe that the statement sufficiently comes to grips with the effects of coal mining operations on cultural resources or with the impact of the program on the preservation and enhancement of the cultural environment. Virtually all aspects of coal exploration and exploitation—that is, all activities that touch the surface of the ground—can affect cultural resources adversely and importantly. The effects can be summarized briefly, albeit without presenting a true measure of their significance. They are primarily associated with the disturbance--usually total destruction--of sites, structures, and objects related to history, prehistory, archeology, architecture, or culture. Since mining usually ranges over a broad area, the effects of one mining venture can descend upon literally thousands of individual cultural resources. In larger terms, such effects may seriously commit all or a major share of a cultural type or subtype and thereby cause uncloseable

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Director, Bureau of Land Management

gaps in future knowledge of the prehistory and history of the locality, region, or Nation. Multiple destruction of cultural resources would also foreclose opportunities to preserve, for public benefit and inspiration as well as scholarly study, representative examples of the resources that comprise a major share of the cultural heritage of the Nation. Aside from the direct effects on cultural resources, serious adversities are caused by the alteration of their environments resulting from mining operations, so that the integrity of even those cultural resources not actually destroyed by mining may be importantly diminished.

The impact of these effects on the cultural environment will depend largely upon the significance and number of cultural resources affected. In areas only minimally investigated to date--such as much of Alaska--the impact of multiple destruction of cultural resources will be major in the sense of foreclosed opportunities for future research. But the true magnitude of the impact may not be measured at all unless it is known whether significant or insignificant, many or few cultural resources were destroyed by mining. In any province, if one sizable mining operation of great extent removed a major share of the resources representative of a particular cultural type, its impact could be quite important. Similarly, if a single nationally significant site or structure were disturbed by a mining operation, the impact of that operation on the cultural environment would be of national importance. On the other hand, it is conceivable that certain mines may operate without disturbing any but a few, comparatively insignificant resources--and with consequently little impact on the cultural environment.

It should be the purpose of the mitigating measures addressed in the environmental statement to identify in advance the cultural resources in a particular mining area so that potential effects, and their impact on the preservation of the cultural heritage of the Nation, region, and locality, could be assessed. Mining operations, on the basis of such information, should be so structured as to avoid adverse effects to the extent possible and to mitigate those that are unavoidable if mining is to proceed.

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Director, Bureau of Land Management

We fail to detect a commitment to such mitigation in the lease stipulations appended to the environmental statement. Those stipulations that relate to cultural resources depend upon the accidental discovery of such resources by untrained persons who would be otherwise occupied with their mining tasks. In practical terms, such a stipulation would afford virtually no protection to cultural resources. The text of the environmental statement broaches an approach that would be much more effective, but gives little assurance that it would be actually instituted.

In view of the responsibilities encumbent upon the Secretary of the Interior under historic preservation legislation and under Executive Order 11593 (not mentioned in the statement), we believe that it should be a tenet of policy that prior to initiation of exploration or operations that could affect cultural resources, comprehensive inventories of historic, archeological, and architectural resources existing within an affected area be compiled. All cultural resources so discovered should be nominated to the National Register of Historic Places if they appear to meet the criteria for nomination. Exploration and operations should be so structured as to avoid, to the extent possible, adverse effects on cultural resources. When destruction or significant alteration of cultural resources would be unavoidable, efforts should be made to recover data and materials through salvage investigation; while such salvage will not eliminate the effects of destruction, it at least assures the preservation of a certain measure of the knowledge cultural resources might provide. Positive measures should be instituted to prevent indirect adversities caused by vandalism and looting of sites, structures, and objects. Finally, in no case should an action affecting any cultural resource listed or eligible for the National Register commence under Federal aegis until the procedures established under Section 106 of the National Historic Preservation Act and Sections 1 (3) and 2 (b) of Executive Order 11593 have been completed.

We recognize that many of these possibilities are given some measure of notice in the environmental statement. But the text is too problematic in tone to provide definite assurance that every reasonable caution will be shown to this integral part of

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Director, Bureau of Land Management

the human environment. We believe that the attention shown to cultural resources in the environmental statement should be broader and more analytic, and we believe that in particular the chapter on mitigating measures should positively affirm that cultural resources will be fully considered during future planning and decision-making and protected where possible.

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

DES-74/53

JUL 9 1974

Memorandum

To: Director, Bureau of Land Management (723)

From: Director, Bureau of Outdoor Recreation

Subject: Comments on Draft Environmental Impact Statement, Proposed Federal Coal Leasing Program (Volumes I and II) (DES-74/53)

We have reviewed the subject draft environmental statement and appendixes as requested in your Notice of Availability received in this Bureau on May 29.

An environmental statement considering the broad range and scope of the Federal Coal Leasing Program must, of necessity, contain frequent generalities. Under the circumstances, we believe that the recreation environment discussions scattered through the two volumes are generally adequate.

We wish, however, to raise several areas of concern tangential to our areas of special expertise which we believe deserve your consideration. They relate to the proposed revised regulations.

Appendix D: Proposed Revised Regulations, Environmental Protection and Reclamation for Exploration, Development and Extracting Operations

1. Page D-2: Section 23.0-1 seems to define environment as consisting of "land, water and air." This may be sufficient from a purely resource management viewpoint, but, in our view, falls short of the sense and spirit of the National Environmental Policy Act, the CEQ Guidelines, and the implementing Departmental Manual sections which speak of the "human environment." Rapid resource development frequently results in impacts which go far beyond the management activity. Severe socio-economic impacts frequently result and the statement seems to imply broader concern. Thus, we suggest that the term "human environment" be used throughout the revised regulations with "land, water and air."

2. Page D-3, Section 23.0-4(g): The term "Operating Plan" is defined to include land reclamation, ". . . of any damage caused by the operation." For presentational and other purposes, we believe an approach having merit

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would be to restrict the "Operating Plan" to exploration, development, and extraction practices. Then add a "Land Reclamation Plan" definition and requirement. The objective of that Plan would be to have the Operator anticipate an end use or uses for the land after extraction is completed and to put the Bureau of Land Management in a partnership position of determining what that end use should be. The planned end use, then, would help determine the land reclamation practices (including special stipulations in the lease) that would be followed. In this way, certain types of reclamation practices and procedures would be followed for grazing as an end use, and other procedures would be followed for recreation, fish and wildlife habitat, commercial, etc. end uses.

3. Page D-7, Section 23.0-5(a)(7): In our view, the amount of reclamation bond to be provided by the operator should be no less than the full amount needed to reclaim the land for an intended end use. This would best be set forth in Section 23.4(a) (page D-12). We note that full bonding seems to be the intent of Section 211.3(b)(12) (page F-7 of Appendix F).

4. Page D-8, Section 23.0-5(c)(1)(i): We recommend that the operator also be required to describe and map current land use on the land under consideration.

5. Page D-12, Section 23.4(c): In our view, the discretionary authority to deny exploratory or extractive contracts to an operator who has formerly failed to comply with exploratory, development, or extraction plans should be strengthened. If this Department, as the Nation's custodian of publicly-owned resources, does not insist on the highest degree of environmental responsibility, then who will? We believe the Bureau of Land Management should insist that contract terms be strictly complied with, and failure of such compliance should preclude issuance of future leases. Thus, we recommend substitution of the word "shall" for "may" in line two.

6. Page D-13, Section 23.7(c): We recommend substitution of "shall" for "may" in line one for the same reasons outlined immediately above.

Appendix F: Proposed Revised Regulations, Coal-Mining Operating Regulations

1. Page F-3, Section 211.1(b): See comment regarding page D-2, Section 23.0-1.

We appreciate the opportunity of reviewing and commenting on the draft environmental statement and the proposed revised regulations.

Lawrence N. Stokes

for James G. Watt
Director

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

DES 74-53

SEP 3 1974

Memorandum

To: William Luscher, Task Force Leader, Bureau of Land Management, Denver, Colorado

From: Assistant Director--Environmental Conservation, Geological Survey

Subject: Review of draft environmental statement on Proposed Federal Coal Leasing Program

As a participating agency on the task force, we have reviewed the subject draft environmental statement. Attached are our detailed editorial and technical comments. We may have further comment on the general scope and content at a later date.

We note that changes were made in the format of the statement after our contributions were submitted, and our material has been modified and rearranged by others to fit the new format. In some cases the original sense and intent have been completely obscured, particularly with respect to hydrology and geology. In other cases only a portion of our original material is used, and in others the emphasis is changed. In a few cases our original contributions survive intact.

Our detailed technical corrections in most cases do not change the format of the text. However, we do believe the format should be changed in places. For example, in the chapter "Environmental Impacts," there are separate sections on hydrology for surface and underground mines, but in the chapter "Measures to Mitigate Environmental Impacts," there is a discussion on hydrology for underground mines, but not for surface mining. Our original contribution consisted of separate parts for surface and underground mining. The surface-mining discussion in this chapter is now fragmented and combined with other discussions and loses much of its intended emphasis and meaning. In the chapters, "Adverse Environmental Impacts that Cannot be Completely Mitigated," "Relationship of Federal Coal Leasing to Long-Term Productivity and Management of the Land," and "Irreversible and Irretrievable Commitments of Resources if Federal Coal is Leased," the format is less than coherent and our original contributions are further bowdlerized.

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

We understand that tentative plans call for reassembly of the task force in September to revise the statement. The Survey stands ready to provide the personnel required to rectify the existing technical errors and prepare whatever additional contributions may be necessary from our areas of expertise and responsibilities. However, in view of the comments above, such assistance must be contingent upon our personnel being solely responsible for making all revisions of their material, in consultation with the Task Force Leader.

Henry W Coulter
Assistant Director--Environmental Conservation

Attachment

cc:
Director, Office of Environmental Project Review
Director, BLM
Assistant Solicitor--Minerals
Deputy Under Secretary Lyons

2

Other comments, referenced by page and paragraph follow:

I-10, first paragraph, first sentence states: "Assessment of environmental impacts is limited to the period before 1985." This hardly seems an assessment of long-term impacts.

II-34, cutthroat trout are not found in Bristol Bay, but rather Prince William Sound is their western limit in Alaska.

II-38 The Aleutian Canada goose presently nests only on Buldir Island in the Aleutian Chain. This summer a group of 41 young geese raised in Patuxent Wildlife Research Center by FWS were released on Agattu Island in an attempt to begin their restoration to former ranges. It is not known at this time whether this transplant will be successful.

II-40 Suggest changing "Alaskan citizens" to "Alaskan residents"

II-42 Suggest checking with the Bureau of Census for more recent population for Alaska. The current population total for the state as of July 1, 1973, was 333,365; of this 16,771 were Indian and 36,416 were Aleuts and Eskimo.

II-77, subsection d, Mineral Industry: This section refers to land disturbance through coal, bentonite, gravel, oil, gas, and gold production. It fails to mention the significant land disturbance occurring from uranium extraction.

Page II-181, the first sentence at the top of the page states: "Most drainages support a substantial trout population for the fishing enthusiast." This is largely incorrect. Most drainages support a significant warmwater fishery, but only some of the headwater reaches of some drainages support trout fisheries in the Northern Great Plains Province. The next sentence states: "Pronghorn antelope hunting is particularly favorable throughout the Northern Great Plains." This is an understatement. Pronghorn antelope hunting in North and South Dakota is important generally to residents of those states. However, antelope hunting in Montana and Wyoming provides a significant recreation resource to nonresidents as well as to residents. The statement should be worded to reflect the national values of the resource.

Page II-185, subsection 10, Human Value Resources, subsection a, Esthetic Values. The first sentence states: "Land forms within the Northern Great Plains Coal Province have a great similarity throughout. It is characterized by rounded, moulded slopes stretching as far as the eye can see, broken only by an occasional uplift or drainage system." These statements connote a rather monotonous characteristic of the area which fails to account for the scenic badlands, buttes, and drainage patterns which provide visual and ecological variety throughout the Northern Great Plains Coal Province.

In Section II, under wildlife, subsections B (Rocky Mountain) and C (Northern Great Plains) mention is not made of the importance of these provinces as wintering areas for bald and golden eagles. The wintering areas coincide with some of the coal regions of the provinces, and warrant particular attention in mining plans.

In Section III, Environmental Impacts, we found two general deficiencies: (1) the impacts are expressed in such general fashion (i.e., no losses are quantified) that it is difficult to realize the tremendous magnitude of the impacts listed; (2) the document fails to impress the reader with all the impacts that the region is about to experience. For instance, not only will there be extensive coal extraction developments as outlined in the volumes, but there will also be far-reaching impacts from related coal gasification plants, steam-electric generation plants, and relocation of other industries nearer the cheaper power sources. Development of other minerals in the area, more agricultural disturbance of prairie grasslands, and huge losses of productive irrigated and dry ~~farmland through~~ saline seep also massively impact the environment.

III-23 and III-24, para. 5 It is probably more appropriate to say that "Railroads are a long-term commitment of land surface to this use" rather than "permanent".

III-36. In the second paragraph, the fourth sentence states: "The head-of-the-hollow fill method (I-108) is of particular significance to the destruction of endangered species and other wildlife habitat." This sentence needs to be substantiated with examples.

III-53, section on Anadromous Fish. The term "anadromous" is consistently misspelled throughout the documents.

III-61, subsection titled Game and Waterfowl Populations. This description of impacts is simply too general to be very meaningful. As a minimum, this section should reflect that people moving to the Northern Great Plains Coal Province will partake of the hunting opportunities of the states in which they will reside. This will exert much pressure on present hunting opportunities for elk, Rocky Mountain goat, bighorn sheep, moose, white-tailed and mule deer, and pronghorn antelope. Heavy pressure is already experienced by the more unique species. A significant portion of the nonresident hunting opportunities would therefore be displaced, aside from the habitat losses attributable to a general influx of people. Two of the more unique game species found predominantly in the Rocky Mountain Coal Province and the Northern Great Plains Coal Province are the pronghorn antelope and the sage grouse. World populations of both these species are distributed mostly within these two provinces. Biologists are uncertain as to just how serious habitat losses will be from mineral development and also from excessive hunting of these local populations. These conditions may materially affect the world-wide populations of these two species. The documents should generally reflect this broad concern.

IV-49. At the top of the page there is a reference to a publication by Plummer, Christiansen, and Monsen, 1968. Appendix A, Selected References, does not list that citation.

IV-49. The fourth paragraph is troublesome. Is it referring to natural replacement by new species or introductions by man? The latter case can have major impact implications in itself, and would be a highly controversial suggestion. Clarification of this paragraph is needed.

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, N. W.
WASHINGTON, D. C. 20006

SEP 4 1974

Dear Mr. Secretary:

The Council has carefully examined the Department's draft EIS on the proposed Federal Coal Leasing Program. This program involves some of the most critical environmental issues facing the Nation. Policies with respect to the development of western coal will, for example, inevitably affect the physical and social environment of a vast portion of the west while having major socio-economic implications for the Midwest and eastern United States.

The draft environmental statement released by the Department of the Interior on May 3, 1974 states that "the major environmental issue is essentially whether or not an orderly system of lease allocation and potential subsequent development is environmentally superior to unregulated leasing." This is not the real policy issue in our view. Rather, in a program EIS the Federal Government should address the following major questions regarding coal development:

1. Is new Federal leasing necessary to meet national energy requirements? What are the alternatives to new Federal coal leasing? If new leasing is needed, how much should occur, when and where should it take place, and at what rate?

2. What are the direct environmental effects of a major effort to develop western coal? What are the indirect environmental effects that will result from the industrialization and urbanization that will follow a major increase in leasing?

3. What are the direct and indirect consequences of a potentially massive shift in the coal industry from the east and Midwest to west?

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We firmly believe that in answering these questions, the analysis in the statement should be based on the most current projections of energy supply and demand, such as those now being developed for the Project Independence Blueprint, rather than on the 1972 West and Dupree projections.

We also believe that the Department has taken too narrow an approach in considering coal policy issues that now face the Nation. The failure to discuss the role of eastern versus western coal is a serious deficiency. We appreciate the fact that this course was taken because the statement was intended to address only Federal coal leasing and that little Federal coal of consequence exists in the east. Yet Federal coal leasing decisions cannot be made in a vacuum. The economic availability of other coal supplies and the relative impacts of their development are critically related to any decision on Federal coal leasing.

It appears that the heart of Interior's proposed Coal Leasing Program is the Energy Mineral Allocation Recommendation System (EMARS); a system that will be used to determine the amount, timing, and location of Federal coal leases. The impact statement, however, presents no detailed description of EMARS that permits readers to make an informed judgment of its ability to evaluate and integrate these critical policy factors. The Council believes that a comprehensive description of EMARS must be presented in the environmental statement and that the role of EMARS in the implementation of the Department's leasing program must be clarified. Analysis of the EMARS methodology should include the evaluation of coal lease stipulations and other mitigating measures. Alternatives to the proposed methodology should also be evaluated.

You and your staff, the President, Congress, other agencies and the public need the best possible information on which to formulate intelligent policy decisions on a program of such importance to the Nation. An adequate program environmental impact statement can, at least in part, serve this purpose. Unfortunately, the informational and analytical deficiencies of the current draft EIS prevent it from doing so. We believe, therefore, that a new draft environmental

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impact statement is necessary. Such a revised draft should be circulated for review and comment according to CEQ's guidelines for the preparation of environmental impact statements.

We believe that a new draft program statement would be the appropriate mechanism for analyzing the critical environmental effects of various coal leasing approaches based on reclamation potential of various soil and climatic conditions, incremental and cumulative effects on water quality and supply, alternative energy transportation modes, and the social and economic changes likely to occur during and after mining operations. The analysis of these issues in such a program statement should provide a framework for more detailed treatment in any future regional impact statement. Without such a framework, the broad policy alternatives necessary for environmental comparison will be inadequately dealt with in the EIS process.

We would be pleased to discuss our views on this subject with you in more detail.

Sincerely,

(Sgd) Russ [illegible]
Russell W. Peterson
Chairman

Honorable Rogers C.B. Morton
Secretary of the Interior
Washington, D.C. 20240

TENNESSEE VALLEY AUTHORITY
CHATTANOOGA TENNESSEE 37401

...974

Director
Bureau of Land Management (723)
18th and C Streets, NW.
Washington, D.C. 20240

Dear Sir:

We have completed TVA review of the draft environmental statement for resumption of competitive leasing of Federal coal reserves from public lands in the western United States and have no comments.

We appreciate the opportunity to review this draft statement.

Sincerely yours,

Peter A. Krenkel, Ph.D., P.E.
Director of Environmental Planning

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Mr. Curt Berklund, Director
Bureau of Land Management
Washington, D.C. 20240

Dear Mr. Berklund:

The Environmental Protection Agency has completed its review of the Bureau of Land Management's draft environmental impact statement entitled, "Proposed Federal Coal Leasing Program."

We believe that the policies which are developed by the Department of Interior to manage coal lands and resources are of paramount importance to the environment. The environmental impact statement (EIS) should describe clearly the policy alternatives, and analyze their environmental consequences. This EIS fails to specify policy alternatives and only describes environmental consequences of coal mining in general. It therefore fails to meet the criteria of an adequate impact statement. We strongly recommend the Bureau evaluate the comments received and re-issue the statement once again as a draft environmental impact statement rather than proceed with the final environmental impact statement.

In accordance with our procedure of rating environmental impact statements at the draft stage, we are rating this statement as category 3 (inadequate). Our detailed comments are attached.

We will be pleased to discuss our comments with you or your staff at any time.

Sincerely yours,

Sheldon Meyers
Director
Office of Federal Activities

Attachment

EPA EIS # D-BLM-01026-00

ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

SEPTEMBER 1974

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Proposed Federal Coal Leasing Program

TABLE OF CONTENTS

A. INTRODUCTION

EPA has completed its review of the Coal Leasing Programmatic draft environmental impact statement. We have found the EIS to be a helpful introduction to the subject of the BLM coal leasing program, however, in its present form, the EIS is not a usable tool for decisions on the key issues of Federal coal leasing. The EIS barely touches the question of BLM management alternatives and the tradeoffs of environmental impact that might be expected.

Recognizing the environmental and other problems in previous coal leasing arrangements, the Department of the Interior in 1971 imposed a moratorium on Federal coal leasing. Under the previous lease program, large blocks of Federally administered lands were transferred to private control without a long range plan for development and rehabilitation. In the past three years the importance of the coal leasing program and its potential environmental implications have become increasingly evident. The estimates of the North Central Power Study and various industry proposals for using western waters and coal would require dramatic increases in coal leasing and a major development program. The question of the ultimate rehabilitation of these strip-mined lands becomes even more pressing when the magnitude of the already leased and potentially leasable areas is considered.

EPA believes that extensive development of this type would require much better control at all government levels--Federal, State, and local--and much better delineation of environmental impacts, both short and long-range, before this extensive development is permitted. In our view, it is essential that the Departmen of Interior as the Federal agency responsible for the conservation and development of this Nation's Federal coal resources, analyze the problems with its coal leasing program, as well as potential solutions to those problems. NEPA itself mandates such a programmatic review of Federal planning processes to integrate environment factors into the overall Federal agency programs (in this case for coal leasing) and to explore long range policy choices for their potential environmental impact.

We understand that the Department of the Interior has established clear policies which give environmental protection first priority in decision-making. However, the draft EIS fails to describe the policy and management alternatives for the coal leasing program and to assess the environmental implications of such alternatives. While the draft EIS does describe general environmental impacts, it does not consider them in the light of alternative policies and as a result provides no basis for evaluating coal leasing programs.

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We have provided below detailed comments on the EIS. A basic concern is that the purposes and goals of the draft EIS are not well defined and the EIS is incomplete in its coverage. In summary, we believe that a satisfactory programmatic EIS must address the real issues involved in policy decisions and must consider the environmental effects of alternatives. EPA believes that the draft EIS fails to address key issues including:

- disposition of existing leases
- necessity for additional leases
- selection of new lease areas
- lease conditions and regulations for environmental protection

We strongly recommend that the Department of the Interior prepare a revised draft EIS which, as a minimum, addresses these key issues and which evaluates the environmental implication of alternative policies.

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II. GENERAL COMMENTS

(1) The EIS Lacks A Specific Focus

From the perspective of a reviewing agency, it is difficult to understand what this environmental impact statement is supposed to accomplish in dealing with the broad subject of a Federal coal leasing program. A reading of the goals or purposes of this EIS does little to clarify the situation.

The summary sheet (p iii) describes the action as "the proposed resumption of nationwide coal leasing," and further: "Utilizing the Energy Mineral Allocation Recommendation System" (p iii). On page I-1a the DOI proposal calls for "a program of competitive coal lease sales" [using EMARS]. The statement is also intended "to cover the action of revising certain [applicable leasing] regulations," namely 43 CFR 211 and 43 CFR 23. Under the section pI-6 entitled "Scope," the statement "describes the existing environment where Federal coal exists and in a general way the environmental impacts of past exploration, production and transportation of coal resources managed by the Federal agencies and methods of restoring lost values." The proviso is added that "neither coal utilization nor the costs and benefits are treated."

Other items of potential importance to the decision-making aspects of a coal leasing program that are discussed on pages I-6 and 7 include: impacts of using low-sulfur Federal coal, the impact of coal gasification, impacts on Indian lands and analysis of legislative proposals (I-8).

Unfortunately, the discussion of even the stated areas of coverage is insufficient in several important cases. It is not clear why coal leasing should be resumed or even why any large-scale coal leasing is proposed. (See discussion under point #2 of our comments). The EMARS system is nowhere presented nor evaluated in environmental impact terms (See discussion #4). The EIS also contains an unexplained and basic deficiency in stating on page I-148 that prospecting permits may again be issued under the EIS proposal. Since the original proposal at the beginning of the EIS is described as a system of competitive leasing, this obvious contradiction confuses what is actually being considered. Discussion #5 of our comments points out a number of basic deficiencies with the proposed environmental regulations. It is not clear to us whether these regulations are suggested, or proposed for adoption.

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While the above mentioned subjects are specified as being under consideration, the EIS fails to analyze those issues under NEPA as potential administrative actions. The EIS describes some environmental impacts in a general way without ever analyzing past coal leasing program deficiencies or the differences in environmental impact between alternative program policies. The EIS then proposes some actions, again without considering their impact or alternative remedies. For example, the EIS does not evaluate whether the proposed EMARS system will represent any environmental improvement over past coal leasing efforts, and if so, how or why. The reader is left without a sense of what has transpired in past Federal coal leasing activities as a yardstick for evaluating any new proposed actions.

The issues that the EIS does not consider or specifically excludes from consideration, are of equal or greater importance than what is considered. EPA feels that demand projections must of necessity talk about the end-uses of coal and their associated impacts, especially when the end use will occur in the same area as production. Indian coal land impacts are discussed cursorily on page VIII-130. Legislative regulatory deficiencies are ignored and the disposition of 22 billion tons of already leased or permitted coal is never specifically discussed.

We believe that a revised draft environmental impact statement is needed to remedy these shortcomings. Specifically, the revised EIS must clearly define the significant issues for the potential coal leasing program, describe the proposed administrative remedies, and assess their environmental implications.

The following is a list of what EPA considers to be valid issues that could lead to subsequent administrative actions. Proposed alternative actions dealing with coal leasing should be the subject matter of a revised draft programmatic EIS:

a. The disposition of present leases (committed and uncommitted for development), prospecting permit applications, and preference right leases

The EIS should discuss the legal status of these particular lands in detail. Related issues include whether lands should be traded (for unified activity in an area), whether exploration can or should be stimulated, and whether some leases should be bought back for environmental reasons.

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b. Whether additional Federal coal should be leased, and at what point the moratorium would need to be lifted; considering the following sub issues:

1. Potential production levels of already leased Federal coal
2. Adequacy of present national and coal derived energy demand assumptions.
3. Total national coal availability, including the merits of stripped mined versus deep mined coals
4. The need for low sulfur fuel and relation to stack gas desulphurization technology
5. Development of Federal coal versus other private, State, Indian and railroad coal in the west
6. The environmental and economic implications of eastern versus western coals including total end-use operating costs (transportation, energy conversion, and reclamation costs)
7. The merits of various regions for gasification and other end-uses of coal, including the water availability, secondary environmental impacts, relative energy costs, and the best use of various sulfur content coals.
8. The amount of reserves for future production needed on Federal leases.
9. Priorities for public land use and whether strip mining will foreclose alternative uses.
10. The ability to reclaim Federal coal areas to their original use.

c. Adoption of EMARS and how it will meet the objectives of environmental protection.

d. Recommendations for changes in the Mineral Leasing Act and other potential statutory changes.

e. Whether present manpower and authorities of BLM, Geological Survey and the Forest Service will be sufficient to protect the environment under existing or expanded Federal leasing.

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f. The environmental impact of revised Federal regulations dealing with coal leasing and reclamation.

g. The need for additional data and studies on leasing, reclamation, and policy changes.

EPA feels that all of the above issues need to be considered in the context of this broad programmatic statement dealing with coal leasing.

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(2) <u>The EIS does not adequately justify the need for new coal leasing.</u>

We are genuinely confused as to the Interior position on renewed Federal leasing. The summary sheet of the draft EIS states that the action under consideration is "the proposed resumption of nation wide coal leasing." The body of the EIS is less definitive in stating that there "is probably not enough Federal coal to meet the nation's needs without additional Federal leasing." (page I-202) Assistant Secretary of Interior Jack Horton made a statement at the public hearing held in Denver on August 19 in connection with the review of this draft EIS that at that point in time, no decision had been reached regarding the need for additional Federal leasing. It is important that the record be set straight to reflect what the Interior proposal is regarding additional leasing in this EIS.

If a decision is proposed to reinstitute leasing on a large scale, it is essential that the revised draft EIS fully demonstrate why such leasing is necessary and analyze alternatives. EPA feels that the sub-issues we have recommended earlier in this paper under our first point should be thoroughly analyzed.

In order to develop a valid supply-demand analysis, the following issues should be discussed.

a. National energy demand assumptions.
b. Future demand for coal.
c. Demand for low-sulfur coal.
d. Demand for Western coal:

-- type of coal
-- BTU content
-- specific use of coal
-- transportation mode

e. Amount of Western coal that can be produced from existing leases (with assumptions about prices, etc.).

f. Amount of Western coal that can be produced from private lands.

g. Amount of coal which could be prod[illegible]ed from leases which have already been s[illegible] but which do not meet environmental criteria.

h. What is the difference [illegible]ich must be made up by new leasing? (questions E4 plus #7, less #5 & #6)

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The preceding analysis is difficult, but can be done in a parametric and reasonable fashion as was done in the Oil Shale EIS. Also, new analyses under Project Independence and the Northern Great Plains Resource Program are available which provide credible baseline data and which will be used by the entire government as a foundation for subsequent analyses such as this one.

Studies have indicated that perhaps as much as 50.2 billion tons of coal are already under private, Indian, State, or Federal lease at this time in the Northern Great Plains area. At first glance, it appears that ample reserves are already available for development. It is important, therefore, that the revised EIS analyze the production from private lands and under existing Federal and other leases, in order to determine whether additional Federal leasing is necessary, and evaluate fully what the environmental impact of additional leasing would be. The most obvious discussion involves the potential production from already leased and/or permitted western Federal lands.

The EIS states that 22 billion tons of coal can be recovered from present federal leases and preference rights. This alone is equivalent to approximately 35 years of current coal production from all sources. The revised EIS should indicate the range of potential production levels from already leased and permitted lands, including environmental alleviations of buying back and/or trading some of the existing leases. Also, an issue of policy regarding the reserve for production needs to be explained. The EIS should indicate what the reserve: production ratio is that would be considered desirable on an individual mining operation, and the reserve: production ratio that should be maintained for the entire Federal leasing system (or regionally).

This EIS did not consider in detail just how much coal can be developed in the near future from private, State, and Indian coal leasing in the western United States. It is believed that just two railroad corporations--Burlington Northern and Union Pacific--have claim to 21 billion tons of coal in the Northern Great Plains area. A recent estimate of the BIA indicated that perhaps 4 to 4.5 billion tons of strippable reserves were located on the leases or prospecting areas on the Crow Indian coal areas. Other holdings occur on the Northern Cheyenne Indian Reservation, Montana and Wyoming State holdings, and private lands in the Northern Great Plains area.

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In addition to the supply projections, the demand projections for western coal must be more adequately analyzed. The EIS analysis of national demand is deficient in part because it uses the West and Dupree study, <u>Energy Through the Year 2000</u> as a base demand projection. That projection may no longer be adequate because it assumed pre-embargo prices and an annual demand growth rate of 3.8%. Since it was published, of course, prices have increased and demand growth has decreased.

The EIS also does not satisfactorily cope with the admittedly difficult task of sorting out demand projections for various types and sources of coal. Reliance on the Bureau of Mines projections for 36 gasification plants by 1985 is tenuous at best. Projections generated by Project Independence should be more useful. Gasification will be in direct competition with any significant new natural gas supplies. The price of natural gas is a critical factor in determining the amount of SNG produced. If a rise in gas prices stimulates new production of natural gas, the need for SNG plants could be delayed by decades. SNG costs for high-BTU gas may range as high as $1.50-2.00 per million BTU and may not be competitive even at $1.00/MMBTU for natural gas.

The location of these potential SNG plants must also be looked at. In addition to the environmental problems discussed elsewhere, SNG plants located in the Midwest may directly compete with North Slope gas, if it is piped in via Canada.

Indeed, there is not even good reason to assume at this point that most or all of these plants, if built, should be fueled by western, strip-mined Federal coal. The chief virtues of western coal for gasification purposes are stated on page VI-2: "Most Federal coal can be classed as low in sulfur content, and most is recoverable by surfacemining methods. These factors make Federal coal preferable for power generation, gasification and liquefaction."

Unfortunately, this statement oversimplifies the best uses of western coal; the merits of western versus eastern coals, and strip-mined versus deep-mined coal, needs a much closer analysis than this summary judgment in the EIS. Also there is reason to regard the most promising use of SNG technology as applying not to low sulfur coal but to the large reserves of coal which contain high sulfur content, or whose energy content is so low that it is economically infeasible to transport the coal to power plants.

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Even if the low-sulfur, easily strippable western reserves are used now on a massive scale, a technology will have to be developed to utilize high sulfur reserves, since the bulk of the country's reserves contain substantial amounts of sulfur. At present, the high-sulfur bituminous coals are unsuitable for any large-scale use, although their proximity to population centers and water could make their use economically feasible through gasification.

We merely point out the uncertainties involved in projecting such a large fraction (11.5 billion tons) of Federal coal at this time as a "committed reserve" (p I-199) for gasification.

A similar situation is projected for power plant use of Federal coal. About 3.2 billion tons of coal is committed to power plants that "are proposed or in operation" (p I-199).

The source of these proposals should be referenced. The description of power plant development on page I-199 gives the appearance that the 3.2 billion tons of coal will be used "in the six Rocky Mountain states." Most of the coal would be burned for electricity transmitted to western or Midwest load centers. The issue of how many power plants should be located in the Northern Great Plains is a controversial policy problem that the NGPRP States are now debating.

EPA wishes to point out that it is primarily interested in seeing that Clean Air Act standards are met with new and existing power plants. We have stated in testimony that two valid ways of meeting such standards are 1) through the use of low-sulfur coal and 2) through the use of stack gas cleansing technology. There is evidence to indicate that stack gas technology is cost competitive with the shipment of low-sulfur western coals. We therefore feel that demand projections for low-sulfur coal be qualified to reflect the option of using high-sulfur coal reserves closer to load centers.

A full demand-supply analysis for western coal needs to be developed. We believe that the work involved in the NGPRP and Project Independence Blueprint will provide more up-to-date information for such an analysis.

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(3) <u>The EIS does not identify how this EIS fits into the overall Department of the Interior activity in regard to a new coal leasing program.</u>

It is unclear how the actual implementation of this coal leasing program as outlined in this programmatic statement will be covered by the NEPA process. Specifically, the revised EIS should identify where EIS's will be written on regional development plans, management framework plans, and specific leases. The EIS should also specify the key administrative policy decisions which, in the judgment of BLM, will not require environmental impact statements, either because they will not have a significant impact on the environment, or because they are covered in this programmatic EIS. The programmatic statement should also discuss where this coal leasing programmatic EIS fits into broader policy decisions on national energy development, specifically those under Project Independence.

This EIS also fails to explain the relationship of the programmatic EIS to the current activities and decision-making within Interior regarding the development of a new coal leasing program. There are obvious data sources (such as the NGPRP interim report, the USGS study of known coal leasing areas, the Energy Policy Project, more recent coal reserve data, and reclamation studies) that should be inputs into the DOI decision framework. A revised draft EIS will be able to take advantage of the extensive work done in the interim.

In this connection, Under Secretary John Whitaker's memorandum of May 16, 1974 (submitted by the Environmental Defense Fund to the record at the Denver public hearing held for this EIS on August 19) provides a very specific study outline to develop management options for many of the issues facing a renewed coal leasing program. A second phase of the EIS process should come after decision options for the various program issues cited in Under Secretary Whitaker's memorandum have been articulated and assessed. In our view, this would then be the time for a new programmatic draft EIS to be released for public and agency scrutiny.

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(4) <u>EMARS, the heart of the newly proposed coal leasing program, is inadequately presented and evaluated</u>

Throughout the impact statement, reference is made to the Bureau of Land Management's <u>Energy Minerals Allocation Recommendation System</u> (EMARS) which is described as the tool that will "encourage orderly production" of Federal coal. Nowhere in the EIS have the authors described the EMARS procedure so that reviewers can estimate the validity and reliability of the system.

On pages I-2 through I-4 of the EIS, a conceptual scheme for how EMARS might work is presented. This is essentially all of the information available on EMARS in the EIS, for what must be considered the heart of the DOI proposal for a new coal leasing program.

The EIS fails to explain the Department of Interior's new ability to select "the most advantageous rehabilitation objective" and fails to list rehabilitation alternatives (page I-2) under EMARS. Nor do the rehabilitation time-table, preplanning procedures, or detailed compliance standards as noted on page I-2 appear in reviewable form anywhere in the statement.

The EIS also implies that environmental and energy policy directives as to the overall role of Federal coal are obtained only from the Interior Department (page I-3). This seems to ignore the expertise of other Federal and State organizations, including the Federal Energy Administration, State planning departments, the Department of Agriculture, the Atomic Energy Commission and EPA.

The allocation process is supposed to disaggregate total energy needs into required demands for coal derived BTU's. What are the criteria by which this is done? Will this allocation take into account private, Indian or State supplied coal? In view of the fact that coals obtained from Wyoming and Montana are being shipped as far east as Wisconsin and to the West coast (as electricity), how does this allocation system determine where Federal coal should come from? It appears that allocation will simply be distributed from the supply side: every BLM coal region will supply a portion of the total Federal coal output. Again, without an actual look at the EMARS model, our comments on this area are purely speculative. However, it does appear difficult to suggest how environmental considerations about where (regionally) coal should be mined, could be integrated into this allocation process.

The revised EIS should indicate where and how the Department of Interior will obtain the expertise to determine areas "where effective rehabilitation can be assured." We are not aware of any substantial effort by Departments other than Agriculture on revegetation/rehabilitation potential of surface-

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mined areas, while the majority of the western revegetation effort has been done by the academic community.

The inclusion of public participation (page I-3) is sufficiently vague for us to be concerned that the site selection procedure might not involve the public. It would appear preferable for the public to be assured of involvement in all processes, and selections.

It would appear that the statement assumes the most critical factors in site selection are "coordinated mining and rehabilitation" (page I-4). There seems to be little consideration given to social or cultural impacts, transportation costs, sulphur content and BTU's, air quality, land use, impact on ground water or surface water, or efficiency of mining recoveries. Even the Mining Supervisor (USGS-Conservation Division) has no responsibilities in any of these areas with the exception of partial authority over mining recovery considerations. Also on page I-4, it is stated that "Base resource data will be adequate in all cases." We do not find any description of the methods to be used to gain these data. Since there possibly are numerous data deficiencies, we are concerned whether any data collection is considered.

In view of the Secretary of Interior's mandate to develop a "planning system to determine the size, timing and location of future coal leases to meet energy needs most effectively," (Page I-1 of EIS), it is important that EMARS be available for thorough review. Without an explanation of the EMARS proposal, there is no indication that this system will meet the stated objectives of the Secretary. We believe that a full explanation of how EMARS works should be added to a revised EIS, including specific examples of how EMARS would operate in practice. The EIS should demonstrate how EMARS represents an environmental improvement over current leasing practices. The EIS should also explain how EMARS guidelines will operate in evaluating prospecting permit applications (p I-148).

The EIS also neglects to explain the relationship of this methodology to the existing BLM land use planning process and to various State priorities for land use. The revised draft EIS should explain how current BLM and State land use planning efforts will be integrated into EMARS decisionmaking.

14

(5) <u>The discussion of administrative alternatives for elements of a coal leasing program is deficient.</u>

Out of 138 pages dealing with alternatives, only 9 pages actually deal with the problems of coal leasing. The remainder are concerned with other energy development alternatives.

Most of these alternative energy developments, as presented in the EIS, are not decision alternatives but rather parallel energy developments. There is thus no assessment of relative environmental tradeoffs from among realistic choices of energy development alternatives to coal, merely a recounting of environmental impacts for separate sources of energy. The studies underway for developing a Project Independence Blueprint will consider such alternative developments. The revised EIS should make use of the actual decision documents that will determine the types and quantities of energy sources that are likely to be developed.

The EIS should have dealt more specifically with administrative choices for resolving the presently known problems of coal leasing. The discussions on pages VIII-129-138 are incomplete in that the most obvious administrative alternative--maintaining the moratorium along the lines of the criteria suggested on page I-5--is not discussed. Given the apparent lack of any near-term need for more Federal coal, and the ability of the present moratorium to allow for reasonable amounts of new coal production under the moratorium, it may be a prudent policy option to continue this approach for some time into the future.

The discussion of the underground mining alternative is deficient in considering only western Federal coal. The underground mining alternative must of necessity consider the extent to which non-Federal (generally deep-mined) coal on a national basis can and will supply some or all of potential coal demands.

The EIS also discusses the need for low-sulfur coal to meet Clean Air Act requirements on page VIII-135. While EPA has itself stressed the need for low-sulfur fuel for steam-electric generation plants, the alternative of using stack-gas technology on higher sulfur fuels should also be given equal priority.

There are other management areas involved in coal leasing that need to be considered in the context of the programmatic EIS. These areas would include manpower sufficiency, adequacy of departmental regulations, and adequacy of the existing legislation.

15

Manpower Sufficiency

The EIS should assess the adequacy of USGS, BLM, and Forest Service manpower to assure successful rehabilitation and how any identified manpower inadequacies will be overcome.

Will enough personnel be available from a range of disciplines to be able to evaluate the full range of environmental impacts in the tract environmental analyses and seek mitigating operating measures?

A third manpower consideration involves how many people will be needed and available to develop the coal resources information and reclamation data under the EMARS competitive leasing arrangement.

A recent study funded by EPA points out the manpower difficulties which the Forest Service has in the field with effectively monitoring and enforcing regulations, permits, and contracts, despite the fact that these documents contain environmental protection provisions ("A Study of Policies, Guidelines and Enforcement Procedures Affecting Prevention, Control and Abatement of Air and Water Pollution Resulting from Forestry Practices on the Flathead National Forest, Montana," University of Montana School of Forestry, 1974). The EIS should consider the problem of manpower availability in a similar context.

Departmental Regulations

A more detailed analysis of specific points of the Proposed Regulations in Appendices D and F of the EIS is included in this review under C. SPECIFIC COMMENTS. A number of general issues are presented here that may require managerial remedies:

a. Environmental Analysis Process

The discussion of prospecting permits and preference right leases in the EIS does not make it clear whether issuance of a preference right lease as allowed under 30 USC Sec. 201(b), is discretionary under the otherwise broad powers granted to the Secretary elsewhere in the same Act (30 USC Sec. 189). Section 201(b) states that upon demonstration to the Secretary that the land (under prospecting permit conditions) contains coal in commercial quantities, "the permittee shall be entitled to a lease under this chapter for all or part of the land in his permit."

It appears that once a prospecting permit is issued, the discretion to lease or not lease for environmental reasons is very limited. Thus the environmental analysis required under the revised regulations may not allow the broad range of choices (including no-action, i.e., no lease) as would be required under NEPA consideration.

16

Our understanding is that the proposed 43 CFR Part 23 and 30 CFR Part 211 do apply to the prospecting permit/preference right process. The prospecting permittee would have to have an approved operating plan which had been subjected to a technical examination, environmental analysis and report under 43 CFR Part 23. A prospecting permit is subject to revocation or termination for environmental reasons. Prior to issuance of a preference right lease, the lessee would have to have an approved operating plan which had been subjected to a technical examination, environmental analysis and report under 43 CFR Part 23. The preference right lease would have to be granted subject to appropriate stipulations. The preference right lessee would have to have an approved mining plan under 30 CFR Part 211. The preference right lease is subject to revocation or termination for environmental reasons. Our concern with this process is that the preference right lease cannot be denied for environmental reasons.

The revised EIS should indicate whether our understanding of the prospecting permit/preference right process is correct and similar to the above describe the administrative alternatives for considering environmental values. This should include the alternative of using only the competitive leasing process until full environmental review discretion is available under the other process.

b. Land Use Plans

Additionally, the respective land administering agencies who control areas of potential coal prospecting are often in a position to develop land use plans well in advance of any actual prospecting applications. Presuming that the land use planning process has already considered the environmental aspects of areas under its jurisdiction including potential coal mining, the environmental analysis may be repetitious of work already done. In such cases, it might be best to insure that land use plans are followed in any such review. It might be considered valuable to write such stipulations into the regulations dealing with environmental reviews, that the USGS will base its environmental evaluation on existing land use plans to the extent that such plans are developed.

c. Application of Regulations to Older Leases

Another issue deals with the application of environmental protective regulations such as 43 CFR 23. At present, the proposed 43 CFR 23 regulations apply only to leases and permits granted after January 18, 1969. How many leases are now actually covered by these regulations and the other basic environmental protective regulations? What is the environmental impact, present and potential, of having only a certain portion of the existing leases under these regulations?

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The policy of the Department of Interior on page I-136 of the EIS states, in essence, that all natural resource development and management programs, as well as leases, contracts, agreements or other arrangements, will conform to applicable Federal and State standards. The policy also states that, all leases, contracts, agreements, and other arrangements that predate current environmental quality standards and do not require compliance with such standards, shall be administered or revised where possible, and appropriate, to require an upgrading of technology in an orderly practical schedule to achieve compliance with applicable Federal and State standards and special stipulations necessary by the Department for proper environmental protection.

How is this to be interpreted in the light of the application of 43 CFR 23 only to leases issued after January 18, 1969? Will it be necessary that the revised regulations have language to the effect that, when leases come up for a 20-year renewal, a compliance schedule will be applied where necessary to insure environmental protection and meeting applicable Federal and State standards?

d. Reclamation Bonds

In regard to existing regulations, bonding requirements are generally considered insufficient to ensure reclamation under 43 CFR 23.0-5(a)(11). The National Academy of Science report on the Rehabilitation Potential of Western Coal Lands, details a list of direct on-site costs for a rehabilitation program in western coal fields. These include land shaping, waste control on slopes, sediment control, seed, fertilizers, mulching, et alia. In western lands, the lowest reclamation cost would probably be in excess of \$200-\$500 per acre. It would appear to be reasonable to set minimum bonding requirements in terms of dollars per acre of reclamation costs. Perhaps a year's advance rehabilitation costs should be set as the minimum bonding fee, by calculating the number of affected acres times the per acre reclamation costs.

e. Bid Prices

The bid prices and sale prices of Federal leases have been extremely low up to this point. Has the USGS developed any criteria for future leasing sales (competitive) that will reflect what a fair return to the U.S. Government would be, as well as to indicate the extent of demand for Federal coal?

18

f. Royalties and Bonuses

The question of royalty payments and bonuses need to be addressed to establish a fair system for competition between small and large coal operators.

g. Production Levels of Coal from Federal Leases

A number of regulatory provisions--the payment of a year's rent to meet the "diligent development" requirement of the Mineral Leasing Act, and low rental fees--may allow leases to be held without any concomitant coal production. The EIS should analyze the environmental impact of this situation and in terms of land use and energy production. Perhaps the approved operations plan for a coal lease should specify a time frame for development. If the lessee does not meet the terms of this time frame, it should be the onus of the lessee to demonstrate why the lease should not be revoked and competitively re-bid.

Proposed Legislative Recommendations

The EIS is deficient in not considering proposed changes to the existing Mineral Leasing legislation, as programmatic alternatives.

The EIS should have addressed various points of issue that might need legislative remedy, for example, is the 20-year period of renewal sufficient to address environmental concerns? What proposed amendments are needed to the prospecting permit system to allow for a complete environmental analysis? The EIS did not point out that a proposed revision of the Mineral Leasing Act (S. 1040) is under consideration by Congress. The EIS should at least outline the effect that such a law would have on the existing coal leasing program.

A similar analysis is needed of current strip-mining legislation efforts. The programmatic statement should point out where environmental protection improvements will be made, should the legislation be enacted.

Because these bills are in Congress, the EIS should also discuss the implications of the option to proceed with the current coal leasing program efforts when the basic legislation may be changed. We do feel that it may be prudent to defer some management decisions that are not immediately needed, if legislative changes are likely.

19

(6) The EIS fails to discuss what data are available to BLM with which to make responsible decisions regarding coal leasing.

This is a most critical aspect of developing a coal leasing program, yet one that is hardly considered at all in the statement. The new EMARS is proposed, yet the criteria on which EMARS operates are not discussed. This discussion is essential in order to determine whether sufficient data are available and have gone into the EMARS model to be able to make the decisions about site locations and reclamation objectives that are claimed for this model. What types of soils, geologic, vegetational, wildlife, water and air quality, and land use data are necessary to utilize EMARS?

Central to any discussion of a resumed coal leasing program is the consideration of reclamation research. Can reclamation in fact be accomplished in the arid and semi-arid areas of the west? What are the risks associated with reclamation, in view of the complete lack of any long-term data? Will water and air quality limitations play a part in determining the amount of Federal coal that should be leased? Will the Northern Great Plains Resource Program interim recommendations play a part in shaping coal leasing policy decisions?

Other data questions deal with the information needed to judge whether more Federal leasing is needed: How much private, State, Indian, and railroad lands in the west are now under lease? How much more can be willingly put into production? How many gasification plants can be located in the west with its scarce water resources? How much more eastern coal is available? How long will it take to develop Federal lands now under lease or prospecting permit? The list of potential issues that we have suggested under discussion #1 should be addressed in terms of whether enough information exists on these issues to make intelligent decisions relating to more coal leasing.

An assessment of what data are available, what can be gathered in the near future, and what data are still needed is critical to an evaluation of any future coal leasing program. For needed data, the program to obtain such data should be outlined.

20

The discussions in the present EIS often fail to clearly delineate what quantitative information presented is reliable, and which is in need of further research. Such an evaluation of data is crucial to the eventual decisions that will have to be made on coal leasing, if this EIS is to be used as a decision-making document. For example, the most definite data available and used involve coal reserve figures for which the USGS is responsible. On the other hand, the demand projections for gasification (p. I-199) are highly speculative, and will be extremely sensitive to shifts in the prices and availability of natural gas, and development of the technology.

21

(7) The EIS does not face the issue of how present leases (committed or uncommitted), prospecting permits, and pending preference rights will be administered.

The extent of the discussion on this issue is confined to a few passages such as the one on page VI-1, where it is stated that "coal will probably be mined from those Federal lands where mineral rights have already been leased regardless of whether or not the proposed EMARS is adopted." The EIS makes no attempt to assess the environmental impact of this de-facto decision. EMARS is predicated upon the twin presuppositions that some areas are better to mine than others, and that vigorous Federal planning and control can minimize environmental harm. It is then difficult to understand why such a large amount of coal land will be exempted from these considerations. The EIS itself estimates on page I-204 that there is enough coal under lease to last 118 years at the rate of production predicted for the year 2000. Are we then to presume that the effect of environmental consideration under EMARS guidelines may not actually be applied until the next century? The EIS should explain whether EMARS criteria and the proposed environmental regulation of Appendices D, E and F will be applied to existing leases and permits in order to determine whether any leases should be bought back or traded for ones with less environmental impact.

The EIS should describe any legal constraints prohibiting changes in existing lesses' stipulations (including new surveillance and enforcement provisions) and assess the magnitude of impact of this constraint. A separate analysis of each type of lease or permit is probably needed to present options as to how these lands can be best administered. The EIS should assess environmental implications of any such options dealing with the existing Federal leases and permits.

There are some 22 plus billion tons of coal now under lease or permits. Some assessment must be made to see how much of the coal is environmentally suitable for mining and economically renewable. The EIS does present a rough study of these factors on pages I-200 to 205. It may be that a special program effort is needed to identify what data are necessary, and to produce such data, to know fairly precisely how much coal these present leases and permit areas can produce with existing technology and reasonable environmental safeguards.

22

(8) The EIS does not fully assess the environmental impacts of a Federal coal leasing program.

The discussion of the environmental impacts of mining, and the subsequent mitigating measures that could be taken to alleviate these impacts, represents the strongest part of this EIS. The analysis provides an excellent checklist of mining. However, the statement does not develop these categorical impacts and measures into a coherent framework that can be applied to decisions affecting a Federal coal leasing program.

The impacts of coal mining are common to all mining operations--Federally monitored or private. The further development of the impact analysis should be to differentiate how Federal activities have alleviated (or contributed to) environmental degradation.

The EIS states on page IV-1 that "these tools [mitigating measures] do not of themselves assure an effective mitigation. This requires three other types of effort involving the Federal administering agencies, local government, the Lessee or operator, and, at times, the public, to insure adequate enforcement. These are administration, cooperation, and comprehensive land use planning." Unfortunately, the analysis stops there. Instead of analyzing how the past system has operated, the description on the following pages outlines the ideal case of how it should operate. Questions such as the extent of present comprehensive land use planning are not asked.

We therefore feel that a full environmental analysis of the past coal leasing program should attempt to look at historical impacts. How effective has Federal reclamation been? How well have mitigating measures to air or water quality degradation been applied? Have adequate surveillance/enforcement activities been performed in the past and at what manpower levels? How realistic is it to suppose early implementation of the ideal system?

We have already argued that the projections of end-uses of coal cannot be separated from a consideration of future mining enterprises. It is our contention as well that a consideration of the long-term cumulative impacts of these end-uses of coal is equally important.

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The Department of Interior is in a position to determine to a certain extent where the emphasis on coal axtraction will be by the ectivities of its various Bureaus. The Bureau of Reclamation has worked closely with the utility industry in planning for the development of western coal resources (North Central Power Study), and the USBR can provide large quantities of water to utilities. The Bureau of Mines likewise can influence the development of gasification technology. We submit that the DOI is in a position to develop and influence a policy of where coal should be mined nationally. Such a policy will have profound environmental impacts, and need to be described and publicly debated.

We stress that the long-term, cumulative impacta and implications of these coal-use policy choicea should be addressed. NEPA guidelines of the Council on Environmental Quality have particularly stressed the need to look at cumulative impacts. The decision to opt for more power plants in the vicinity of strippable Federal coal, or to recommend gasification plants for similar demands on the western resource, will have more profound impacts as each successive industrial operation is added.

One obvious example occurs in tha Four Corners area where further coal leasing will indirectly but surely contribute to a continuing air quality degradation with additional power generation facilities end coal-associated industrial facilities. The proposed gasification plants would likewise consume a considerable total of the available water in this extremely arid area. Other issues include the effects of Western ways of life, especially for the Indians, from large population influxes; wildlife effects; the stresses on existing municipal services and the need for expended services.

We suggest that this EIS may be the proper point to focus on the environmental implications on a national basis of coal-related activities. Should gasification plants be close to population centers and nearby coal fields or near the NGP strippable deposits?

A complete delineation of all likely secondary impacts mey be beyond the scope of this programmatic statement. The revised statement, however, should be able to identify major national environmental and social issues that could result from a policy to develop one coal resource over another.

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For example, there is likely to be an economic and social impact on the eastern coal mining community, if western coals are favored. Railroad capacity may be exceeded in certain areas if coal is mined in large quantities from a region.

The revised EIS should sketch out as comprehensively as possible what the major environmental issues are in a renewed Federal coal leasing program. We would recommend thet a framework be developed that will allow an environmental comparison of at least the following points:

a) Comparison of existing BLM, USGS & FS practices dealing with the leasing of coal and any new administrative remedies available (revised regulations, lease royalties, enforcement actions)

b) Comparison of policy decision options on where to develop mining: specifically, eastern versus western coals, one coal province versus another, and within a given province, "superior site" locations versus ones that are environmentally harmful.

c) Policy alternatives of where gasification plants and power plants should be located.

d) Alternative levels of coal development.

e) Comparison of effects among past actions based on insufficient data, and new decisions thet have the benefit of identifying data needs, and utilizing more recent studies.

f) Comparison of various methods of coal extraction--strip mining versus deep mining.

g) Comparison of the effects of competitive leasing and prospecting preference right leasing.

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(9) <u>The DOI should incorporate the interim results of the Northern Great Plains Resource Program (NGPRP) and Project Independence efforts in developing the coal leasing program.</u>

As a background to this discussion, it may be useful to reiterate a number of quotes taken from Mr. Jack O. Horton's testimony before the Senate Subcommittee on Minerals, Materials, and Fuels on March 13, 1974. In response to numerous and varied questions, Mr. Horton stated the following:

> Our concern about the uncoordinated nature of (a veriety of) actions end about our own respective responsibilities in the Northern Plaina coal area led Interior to hold in abeyance actions that would establish future commitments.... In this period the Department undertook several related actions designed to structura a program for orderly development end environmental protection of the Northern Great Plains. These steps include the Northern Great Plains Resources Program (NGPRP), Energy Minerals Allocation Recommendation System (EMARS), and a programmatic environmental impact statement on the Federal coal leasing program.
>
> Presently, the Department is executing the Secretary's short-term coal leasing policy which defers decisions which entail major new commitments of resources in the region, but allows for some coal leasing to provide continuation of existing mines and to assure conservation of the coal resource. We plan to maintain this posture until these programs are <u>completed</u> [emphasis added], which we estimate will be September 1.
>
> Although a great deal of work is underway, and in some instances, preliminary data [have] been prepared, these [NGPRP] reports are not complete. Therefore we do not have available at this time much of the data and analyses thet we expect to assemble in the interim report which will be pertinent to decisions the Department will address. Throughout FY 1975, the interim report, further work on NGPRP, investigations related to EMARS, and the EIS on Federal coal leasing will be useful to helping the Department examine choices with respect to decisions on matters such as: -- new Federal coal leasing policy....

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As you know, EPA has been closely involved in the activities of the Northern Great Plaina Resource Program. It appears to us that the EIS was prepared without the data which Mr. Horton indicated were pertinent to coal policy decisions now before the Department. There are substantial differences among information contained in the EIS and information contained in the drafts of the NGPRP Work Group Reports and of the Interim Report. Most importantly, the EIS neglects the deficiencies in exiating data regarding coal development that heve been identified by the NGPRP, and therefore it neglects the problem of obtaining the data and the time frames within which the data are to be obtained.

Both NGPRP and Project Independence have developed scenarios for the end-uses of coal from the Northern Great Plains (gasification, power plants). There are two attempts to look comprehensively et the environmental, aocial, economic and industrial impacts as a result of these development acenarios. Air and weter constrainta, sociological effects, the competing uses of the land aurfaces, limitations of reclamation, and other mineral resources are areas that must be looked at in proposing economic development alternatives. As a member of the NGPRP study team, EPA feels that such information would be vital to Interior decision making on the future of Federal coal leasing. The bulk of present leasing on Federal lands has occurred in precisely the Northern Great Plains area.

We strongly urge the Department to prepare the revised draft EIS with the most recent data available from the NGPRP study and from Project Independence.

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C. SPECIFIC EIS COMMENTS

(1) Comments on Body of the EIS.

a. It is our impression that the Four Corners Plant required closer to 7 X 10^6 TPY (page I-59).

b. Table 10 (page I-67) appears to include Federal and other coal. It is not clear from either the Table or the text and since no equivalent table exists for Federal coal, the question is unresolved for the public how much of the total resource is in Federal ownership.

c. It may be possible that the entries for longwall mining could be designed to allow pulling pillars after the longwall panels are completed (page I-93). But shallow longwalling or longwall stripping would eliminate the specific potential for irregular subsidence over the haulways.

d. Bucket wheel excavators have been ordered for the AMAX Bell Ayr Mine in Wyoming (pages I-97 and I-99). That does not weaken the generalizations regarding the applicability of bucket wheel excavators. Another relatively inconsequential point is that not all western coals are drilled and blasted (AMAX-Bell Ayr for example) (page I-99). Wherever Dave "Johnson" Mine and Plant are referenced, it should be Dave Johnston. Figures 15 through 21 show a larger outslope area than is generally desired.

e. On page I-114, it should be noted that in the vicinity of Gillette, Wyoming, it will be necessary to plan the sequential mining of the entire river basin if one is to avoid internal drainage. The great thickness of coal overlain by thin overburden in that area will result in numerous irregular depressions that will have little relationship to the original geomorphology.

f. The recognition of need for lining of settling ponds (page I-123) is good, but it is questionable as to the reliability of clay liners. Usually all earthen liners leak to some degree. Perhaps one should first identify the potentially toxic parameters of the refuse and determine whether reactive linings would have more merit. Seldom are sites found that are "naturally impervious."

g. The discussion of applicable laws relating to coal leasing and mining on page I-132 should highlight the 1972 Water Pollution Control Amendments (P.L. 92-500),

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since the policies and regulatory procedures within the Act represent a much more comprehensive attack on water pollution problems. Specific requirements would include obtaining a permit under the National Pollutant Discharge Elimination System for any discharge to navigable waters.

h. On page I-157 a total of 531 "active Federal Leases" is quoted. On page I-160 a total of 530 is indicated. The numbers are used interchangeably. Table 13 adds to 531. A minor point.

i. Statements such as, "There are four Federal leases for 2,680 acres on the eastern edge of the basin in Elbert County. This area could be surfaced-mined..." infer that some assessment of the acceptability of mining has been made (pages I-164 and 165). We see no evidence that the impacts have been evaluated. Similarly, it is stated (page I-169) that "water may be available from the Yampa River." There is no indication that an assessment of water availability, especially in terms of in-stream requirements, has been made. The same comment applies to page I-170, third line.

j. The caption on Figure 23-D (?) also (page I-185) should indicate that the Western Energy Mine at Colstrip has greater potential for growth - to 20 X 10^6 tpy. Figure 23-E should be North Dakota.

k. The tonnage of lignite for a 250 million SCF/day gasification plant would be approximately 10 million tons per year, depending upon the BTU content of the coal (page I-188).

l. The discussion of underground mining (page III-26) should indicate that irregular subsidence is often a function of current underground mining technology and need not be a result of advanced underground mining techniques such as longwalling. Further, acid drainage is not a known characteristic of western underground coal mines where the majority of the Federal coal lies. Alkalinity is more likely--often in the form of sodium and sulphate. On page III-29 perhaps it would be better to restrict damaging subsidence to "irregular" subsidence since it is possible that regular, "controlled" subsidence may not destroy as many surface uses of the land as does irregular, uncontrolled subsidence.

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m. In cases of clayey spoils left on the land surface, infiltration will, in fact, decrease and recharge may decrease (page III-35). If vegetation systems used for rehabilitation are more water-intensive than pre-mining systems, then recharge may decrease. These two impacts are in addition to those quite valid ones discussed in this section of the statement.

n. Is the increase in sediment yields listed on page III-39 applicable to the west as well as Kentucky?

o. Do data exist to show that the hydrologic conditions of "prairie pothole" topography can be recreated or will permeabilities and water tables be too altered to allow rehabilitation?

p. The range of from 1,500 acre feet of water per year for a 1000 MW coal fired power plant appears (page III-75) low if typical water use practices are assumed. The Northern Great Plains Resources Program (Water Work Group) assumed a requirement of 19,000 acre feet per year.

q. On page IV-20, the statement is made that "good water can be stored during periods of high run-off to use to dilute poor quality water released to streams during periods of low run-off." Dilution is not an acceptable method of pollution control, and the emphasis should be on treatment of the waste water to eliminate the pollutants. This is especially critical in the areas where water quality is limited.

r. The section addressing treatment of acid water drainage (page IV-21) is highly oversimplified. For example, treatment of acid drainage is a continuing, long term need and responsibilities are seldom assigned at an early date.

s. Bentonite cannot really be considered an impermeable sealant for long-term use (page IV-27).

t. Disturbed aquifers (page IV-28), as long as the area is refilled, will be reestablished to the degree that the water table will be reestablished. The storage of the resultant aquifer may be affected by a change in permeability and storage volume.

u. It appears to be suggested, on page IV-30, that strip-mine ridges should be left in parallel ridges. This concept is usually abandoned in favor of reclamation to approximate original contours. The implication is also in conflict with item #2 on the following page (IV-31).

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v. Gouging areas also trap wind-blown fines if windy conditions prevail prior to establishment of vegetation (page IV-37).

w. The blasting of overburden with ammonium nitrate would, if nitrate is left behind in detectable quantities, contribute to nitrogen contamination of percolating water.

x. On pages IV-69 and IV-71, the use of dry cooling towers is given as a mitigating measure for emission of water vapor, consumption of water resources, and thermal pollution. Dry cooling towers do hold much promise for thermal control in the stream electric generating industry. Emphasis should also be placed on other mitigating measures that can be applied using evaporative cooling towers and possible use of the waste heat.

y. It would appear that there is an error on page V-16 if a 1000 MW plant will require 1000 X 1,500 acre feet per year or 1.5 X 10^6 acre feet per year. Perhaps it was meant to be 15000 acre feet per year for a 1000 MW plant.

z. Captions to photographs on page V-27 incorrectly infer that (1) the Dave Johnston power plant is in compliance with air pollution control standards and (2) that emissions of less than 2 microns can be only slightly reduced regardless of the technology employed.

The Dave Johnston power plant is currently not in compliance with emission standards except for the fourth unit. The remainder of the plant is on a timetable to meet standards. Scrubbers are capable of removing 95-99+% of particles smaller than 5 microns. It is the submicron particles that are most difficult to collect.

aa. The discussion on page VI-2 neglects the fact that 37.5 percent of royalties directed to States can presently be used only for schools and roads and that the majority of the funds go for water resources projects of the Bureau of Reclamation anywhere in the United States.

bb. A surface mine producing 5 X 10^6 tpy is usually considered to require 200 employees. Anywhere from 100 to 250 additional people may be employed in "support" capacities, including community services. Multiplying by 2 for families, we estimate between 600 and 900 people per mine. The figures used on page VI-2 are thus confusing. It may be closer to fact to estimate that 30 surface mines would bring about 22,500 (750 X 30) people to the areas mined. Of course coal conversion facilities would bring many more.

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cc. The site index discussed on pages VI-7 - 10 is instructive--if one is mining in Douglas Fir country. Most of the Northern Great Plains has little Douglas Fir underlain by coal. We question the potential for increase in the site index for the Northern Great Plains as the clay content approaches 45 percent. That seems quite high to the extent that infiltration will be reduced.

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(2) Discussion of Proposed Revised 43 CFR 23 and 30 CFR 211 Regulations

The reason for inclusion of this appendix to the EIS is unspecified and unclear. Furthermore, we are uncertain as to why the excerpt from the U.S. Forest Service Manual was included and the Forest Service "Proposed New Regulations" (36 CFR Parts 251, 252, and 293) were not included. The EIS also does not evaluate the environmental pros and cons of the revised sections. However, we did take this opportunity to review the appendix and have the following comments to offer.

General

We suggest attention to E.O. 11752, which requires heads of Federal agencies to ensure that all facilities (including lands) under their jurisdiction comply with "applicable standards specified in section 4 of this order... on a continuing basis." Section 4, in turn, specifies that the standards to be met include:

> (1) Federal, State, interstate, and local air quality standards and emission limitations adopted in accordance with or effective under the provisions of the Clean Air Act, as amended.
>
> (2) Federal, State, interstate, and local water quality standards and effluent limitations respecting the discharge or runoff of pollutants adopted in accordance with or effective under the provisions of the Federal Water Pollution Control Act, as amended.
>
> . . . .
>
> (4) Guidelines for solid waste recovery, collection, storage, separation and disposal systems issued by the Administrator pursuant to the Solid Waste Disposal Act, as amended.
>
> (5) Federal noise emission standards for products adopted in accordance with provisions of the Noise Control Act of 1972 and State, interstate, and local standards for control and abatement of environmental noise.
>
> . . . .
>
> (7) Federal regulations and guidelines respecting manufacture, transportation, purchase, use, storage, and disposal of pesticides promulgated pursuant to the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended by the Federal Environmental Pesticide Control Act of 1972.

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The Executive Order further allows the head of a Federal agency to require lessees or permittees to assume full responsibility for complying with standards for the prevention, control, and abatement of environmental pollution, for activities carried out on Federal facilities.

Regulations for coal leasing on Federal lands should conform to the requirements of the Order with respect to conformance with applicable standards for the prevention, control, and abatement of environmental pollution.

43 CFR 23

Sec. 23.0-5(a)(5). This section makes reference to a Federal Pollution Control Administrator. The Administrator of the Environmental Protection Agency has assumed the responsibility of the former FWPCA Administrator for the general application of Federal air and water quality laws. This reference should also be corrected in Section 23.0-5(e)(5).

We believe it would be helpful for representatives of EPA and Interior to discuss how this section would be implemented, and perhaps develop an administrative agreement on how standards would be applied and enforced.

Sec. 23.0-5(a)(6)(iv). This section is incorrect; applicable air and water quality standards must be met. Any revision of water quality stream classifications must be made by the State with the approval of the EPA. The function of maintaining the non-degradation provisions of the Clean Air Act and the Federal Water Pollution Control Act, as amended, has not been delegated to the Department of the Interior. Recent court decisions have required EPA to develop non-deterioration regulations for areas where air quality is better than the already promulgated secondary ambient air quality standards. These non-degradation regulations have been promulgated in proposed form. EPA must also approve any deterioration of water quality in overall planning efforts and permit requirements designed to meet applicable effluent limitations guidelines and State water quality standards.

This section should be revised to reflect the requirements of E.O. 11752 regarding compliance with environmental standards on Federal facilities. We suggest that subsection (iv) be revised to stipulate that the authorized officer may prohibit or restrict operations which might result in "Any violation of standards for the prevention, control, or abatement of environmental pollution as set forth in Section 4 of Executive Order 11752."

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We also believe that Section (6) should allow the prohibition of operations on any tract if the degradation of environmental, land, social, or other values is too great over too long a period of time, e.g., if revegetation to an agreed-upon land use is not possible in a reasonable period of time or if technology is not yet available or refined to minimize significant adverse impacts.

Sec. 23.0-5(a)(7). This section and section 23.4 apply to bonding. As noted earlier in our general comments on the EIS, we believe existing bonding requirements are generally insufficient to ensure reclamation. Minimum bonding requirements should be established in terms of dollars per acre of reclamation costs including such costs as land shaping, waste control on slopes, sediment control, seed, fertilizers, mulching and other requirements. We suggest a year's advance rehabilitation costs should be set as the minimum bonding fee by calculating the number of affected acres times the per acre reclamation costs.

Sec. 23.0-5(a)(11). It should be inappropriate in western lease areas to release any bonding after only one growing season. From 5 to 26 years may be required to reestablish proper vegetation, and bonding requirements should be continued until revegetation is established.

We recommend that the regulations be revised to reflect the criteria that are available to indicate how long successful revegetation work is required to insure permanent rehabilitation in various geographic areas. These criteria should include rainfall and the need for supplementary irrigation, soil conditions, temperature variations, and the type of ultimate land use objective desired, as well as any other factors necessary to determine strip mined lands reclamation needs. We further recommend that no reclamation bond monies be returned until enough money is guaranteed to ensure a self-sustaining vegetative cover over a specified minimum period of years.

Sec. 23.0-5(c). The description of the required operating plan does not appear to be sufficient in detail to insure a complete evaluation of the impact of proposed activities. A detailed list of the information required to make an adequate environmental analysis should be developed for this section.

This section of the regulation should also include the provision stated on page I-160 of the EIS which relates to compliance with relevant State reclamation requirements.

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Section 23.0-5(c)(5)(i). This section should be expanded to include air and water and other possible impacts which pertain to conformance with applicable environmental standards.

30 CFR 211

Early in 1974, EPA had occasion to review draft regulations for 30 CFR 211 and subsequently representatives of EPA met with U.S. Geological Survey representatives to discuss points brought out as a result of this review. At this time we would like to reiterata our previous comments and add some additional points that arose during the EIS review.

Sec. 211.3. After our earlier review, EPA requested that the description of the responsibilities of the "Mining Supervisor" should include provisions which promote consultation with Federal and State environmental agencies and that review of major actions and decisions of the Mining Supervisor should be initiated by the appropriate Departmental authority upon substantive complaint by a Federal or State agency whose areas of jurisdiction are affected. At a subsequent meeting with the Survey it was pointed out that the Interior Department Manual would provide a detailed outline of the responsibilities of the Mining Supervisor, whereas the regulations specify only the direct environmental requirements of the mining operator. The requirement to consult with appropriate State and Federal environmental regulatory agencies and to factor into the mining operating plan those measures necessary to comply with environmental laws rests first with the operator. In view of this, it was agreed that the addition of the statement, "Such measures shall include the actions necessary to meet the requirements of the applicable Federal and State environmental regulatory agencies," to Section 211.10(b)(3)(ii) would resolve the issue. As noted in our general comments, reference might be made to E.O. 11752 for specific environmental pollution control requirements to be met.

Sec. 211.3(b)(1). Again there is a problem with non-specific language pertaining to the responsibility of the Mining Supervisor. The statement "Examine frequently the lease, permit, or license..." (emphasis added) is much less specific than the statement on page IV-15, line 8 of the EIS which states, "After the permit or lease is issued, the GS assumes management and inspects active leases at least three times a year and inactive leases once a year."

Is this statement a requirement from the Interior Department Manual? Why does the regulation not contain this language?

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Sec. 211.3(b)(2). The requirement that reclamation work be "completed within reasonable prescribed time limits" is equally vague. This point was raised in our earlier comments. We assume that the "reasonable prescribed time limits" referred to are those specified in the mining plan required under Sections 211.10(b)(3)(iv)(A) and (c)(3)(vi)(A), however, we feel that some time definition is essential. Several State regulations do specify such language.

Sec. 211.4(b). It is presumed that in accord with 211.1(e), provisions of 23.0-5(a)(6)(iv) of 43 CFR 23 govern. Some question also exists as to the ability of parties other than the operator to appeal unwise decisions made by the Mining Supervisor.

Sec. 211.4(g). The regulation is inadequate in its discussion of criteria for successful rehabilitation.

We suggest that this section be expanded and should specify that reclamation measures should at least satisfy all applicable Federal and State requirements.

Sec. 211.4(b). We feel that the analysis listed is insufficient to accurately determine the potential toxicity of spoils to selected species of vegetation.

Sec. 211.5(a). While we agree that the regulations should not force disclosure of competitive information protected by law, it is often necessary to examine geological and/or geophysical records in order to adequately assess the impacts which will arise from the mining activities. EPA favors including a mechanism for appeal of this provision by parties who demonstrated a legitimate requirement for such information, especially where there is administrative discretion regarding access to information.

Sec. 211.10. The section on Maps and Plans neglects estimates of the people employed and their disposition.

Sec. 211.10(d). Exploration and mining plans should not be changed without adhering to public review procedures. Also, this section requires that the operator submit his statement of intent to modify the mining plan prior to effecting any changes.

Sec. 211.24. On Page F-19 and 20, "Protection Against Mine Hazards" is presented, and is a revised version of §211.24 Requirements" under Provisions for Disposal of Waste of CFR Title 30 Mineral Resources. The older §211.24 Title 30 CFR requirements read that:

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(a) Slack and refuse to be so disposed of as not to be a nuisance. The lessee shall dispose of waste, slack, refuse, and water from a mine and waste and sludge....

Under 211.51, as proposed:

The operator shall dispose of all solid wastes resulting from the mining and preparation of coal in a manner that will not cause air and water pollution and will not spontaneously ignite.

The omission of "waters" or "waste waters" from the proposed regulations is significant and should not be made. Also, does 211.51 supersede 211.24?

What is the relationship between these regulations and those enforced by the Mining Enforcement and Safety Administration (e.g. 30 CFR 77 which relates to refuse piles).

Sec. 211.31. It is unclear as to how this part will be applied to surface mining of multiple seams. What is "sound economic practice" in terms of depth, BTU, thickness, etc.?

Another difficulty with this provision centers around the potential environmental damage caused by inadequately sealed mines. The environmental problem has been mainly that of acid drainage in the East and would not pertain to the bulk of public domain, acquired and Indian lands. We would recommend, however, that the following provision be added:

...except where there is potential for severe and continuing environmental damage and/or with the written approval of the Mining Supervisor....

A general comment is that while the proposed thrust is to provide for ultimate maximum recovery, the emphasis is on room and pillar-type mining which by its very nature leaves considerable coal underground. It is suggested that possibly the emphasis could or should be shifted to a more productive coal mining method such as longwall systems where a higher coal recovery rate is possible. Additionally, longwall mining would have two favorable environmental considerations: (1) caving could be practiced on large areas, or (2) stowing of the refuse (and other material) behind the face could be practiced. Both caving and stowing would eliminate many of the openings and void spaces that create long-term environmental problems.

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Sec. 211.37(a)(1). Who is to determine "possible future uses" of strip mined areas?

Sec. 211.38. If such non-leased blocks exist, they should be identified in the mining plan and the land subjected to leasing as in all other cases of Federal coal.

Sec. 211.39(d). Our original comments suggested a clarification of the responsibilities of the mining operator when the operation has been temporarily abandoned. At the meeting with the Survey it was agreed that the regulations would include language specifying a requirement that the mining operator must adhere to the original mining plan during temporary abandonment.

Sec. 211.72. There should exist authority to make null and void the contract if the operator does not meet the requirements of the lease or of the regulation.

Interior Department Manual

We believe that those provisions of the Interior Department Manual which provide operating requirements pertaining to the responsibilities of the mining supervisor and other requirements pertinent to the environmental issues involved with the Federal coal leasing program should be appended to the EIS, in addition to the Department regulations.

OFFICE OF THE DIRECTOR

United States Department of the Interior

BUREAU OF MINES
WASHINGTON, D.C. 20240

July 29, 1974

DES 74-53

Memorandum

To: Director, Bureau of Land Management

Through: Deputy Assistant Secretary--Energy and Minerals AUG 7 - 1974

From: Director, Bureau of Mines

Subject: Draft environmental statement, proposed Coal Leasing Program, Bureau of Land Management

We appreciate the magnitude of preparing a programmatic environmental statement dealing with such a complex subject as Federal coal leasing. While the mechanics of EMARS are fairly well explained and environmental factors discussed, the real thrust of the Federal coal leasing program is left unstated. The statement should spell out the thrust of the leasing program, the factors that should be considered, and how each factor must be weighed in order to develop decisions with a reasonable degree of uniformity for protecting the best interest of the country. We believe that emphasis should be placed on the thrust or intent of the program giving adequate consideration to its positive and beneficial impacts rather than placing primary emphasis on its negative impacts. In light of our Department's responsibility to see that sufficient coal is developed to help meet our energy needs, we believe that the impacts must take into consideration the entire human environment as defined by NEPA. We must strike the right balance between our need for environmental protection and our energy requirements. The environmental statement needs revision to attain this balance.

The statement is unnecessarily lengthy and repetitious. Apparently little editing was done before it was released. Some sections will require more editing than others, and at least one section, "Present Coal Leases," pages I-160 to I-192, should be rewritten. An environmental statement often requires some repetition from one section to the next, but unnecessary redundancy within any one section encumbers its understanding. A writer-editor could eliminate the repetition prevalent within many sections, decreasing the bulk of the text and improving its clarity, unity, and coordination.

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Memo. to: Director, Bureau of Land Management, Subj: Proposed Coal Leasing Program, Bureau of Land Management

Inferences are found throughout the statement that are, without question, opinions rather than facts. It is implied, repeatedly, that archaeological, historical, and cultural sites exist on every deposit of coal that can be mined by surface methods and on every proposed mine-plantsite. Some of the unreasonable and prejudicial statements that appear will be noted in the specific comments. The inference is made many times that if surface or ground water comes in contact with coal or carbonaceous shale, the water will be polluted, mainly from trace elements. A remote possibility of such pollution exists under certain conditions, but science has yet to determine the concentrations of most trace elements that are detrimental. We suggest that pages 70-71 of the Secretary's Second Annual Report under the Mining and Minerals Policy Act be reviewed and considered for inclusion in the statement. Many small communities and rural residents in the Northern Great Plains obtain their water supply from lignite aquifers and a number of communities in West Virginia, Ohio, and Pennsylvania pump good potable water from old coal mine workings that act as excellent reservoirs.

Much of section III exaggerates the adverse environmental impacts of coal mining. Unreasonable bias is particularly obvious in pages III-52-64 that obviously were written by persons totally opposed to mining and unappreciative of its vital importance. It is strongly recommended that this 12-page section be rewritten, preferably by someone having a more objective viewpoint.

Photographs appear throughout the publication. Although the text does not refer to such photographs, they supposedly have been placed where they will explain or supplement the text, and some of them do. However, some do not apply at all, and others seem to be included only for their sensational impact in the same manner they might be used in a tabloid newspaper. A list of photographs that should be deleted are included with our specific comments. Also, the photograph titles should be listed in the table of contents to reflect the format of a good, factual report. Sources and credits for figures and pictures should also be shown.

The environmental statement should also point out that the revenue from minerals exceeds that from other uses of Federal land, and that the American economy is completely dependent upon minerals. Although we do not wish to belabor the point, we cite the following quote of Secretary Morton published as the foreword of Geological Survey Professional Paper 820: "Minerals and mineral fuels are literally the cornerstones of modern life. They constitute the source materials for most of the things we

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Memo. to: Director, Bureau of Land Management, Subj: Proposed Coal Leasing Program, Bureau of Land Management

use, and they supply the energy that powers our machines and heats and cools the air where we live and work. In short, they are the physical source of most of the necessities, conveniences, and comforts of life in the United States today."

Specific comments follow. In addition, we enclose a marked copy of the statement in which these comments have been noted.

Acting Director

Enclosure

One important aspect of mining in arctic areas which was not addressed at all is the feasibility of mining to any extent in areas underlain by permafrost. This problem should receive extensive development under Impacts Unique to Certain Provinces, chapter III, part S.

This permafrost problem, along with detailed analysis of the effects of coal mining on reindeer and caribou, needs a great deal of elaboration, especially in the event that no further ES's are to be prepared.

The alternative section dealing with oil resources could be broadened to include specific impacts of oil development on fishery resources. Some suggested references are:

Acute toxicity of petrochemical drilling fluids components and wastes to fish. April 1973. M. R. Falk and M. J. Lawrence. Technical Series No. CEN T-73-1, Resource Management Branch, Department of the Environment, Freshwater Institute, Winnipeg, Manitoba.

Effects of Prudhoe Bay crude oil on molting Tanner crabs, _Chionocetes bairdi_. John F. Karinen and Stanley D. Rice. National Marine Fisheries Service, Auke Bay, Alaska.

In section I, subsection A, _Proposed Action and Alternatives_, pages 1-12, mention is made that interagency efforts will be needed to supply information for EMARS and that ongoing baseline studies will continue to keep the program current. Is there coordinating machinery set up to get input from cooperating agencies, such as, the Forest Service, Fish and Wildlife Service, other agencies, universities or industries that might

be gathering baseline data about plant and animal communities of leased or proposed lease sites?

United States Department of the Interior
BUREAU OF MINES
P. O. Box 550
Juneau, Alaska 99801

July 1, 1974

Memorandum

To: Jerry C. Wickstrom, Acting Chief, Planning and Program Coordination Staff, Bureau of Land Management Anchorage, Alaska

From: Chief, Alaska Field Operation Center

Subject: Environmental Impact Statement, Proposed Federal Coal Leasing Program, Volumes 1 and 2.

Enclosed are review comments on subject EIS by Robert Warfield and Tom Pittman, mining engineers. Some notes from Tom Pittman's worksheet also are enclosed.

John J. Mulligen

enc.

ij

P. O. Box 550
Juneau, Alaska 99801

July 1, 1974

Memorandum

To: John J. Mulligan, Chief, Alaska Field Operation Center

From: Supervisory Mining Engineer, Alaska Field Operation Center

Subject: Review of Draft Environmental Impact Statement (DES 74-53), Proposed Federal Coal Leasing Program.

The environmental impact statement is chiefly concerned with coal lease sales and operations on Federal lands through the Bureau of Land Management's Energy Minerals Allocation Recommendation System (EMARS). This program primarily involves 85 million acres of identified coal reserves land located in the Northern Great Plains and northward along the continental divide from New Mexico and Arizona through Montana.

Alaskan coal lands are not considered important in this program. Measured reserves are listed at only 8 billion tons (0-1,000 feet overburden) for the entire Pacific Coast Coal Province, comprised of all coal fields in Washington, Oregon, California, and Alaska. Only five of the nationwide total of 531 Federal coal leases are in Alaska. Most of the coal in Alaska is in the inferred resources category and described as too far from adequate transportation and markets to be economically important to this program.

This statement will have lasting and important significance to the future exploration, utilization, and conservation of coal in Alaska. It is defined as relating to all Federally administered lands underlain by coal (page I-11). It states that EMARS will also analyze the effect of unplanned patterns of coal ownership (including leases) on future industrial development of these rural regions (pages I-11, 12). The effects will be important and may become restrictive, under this stated philosophy, to coal land not Federally administered. The Statement says coal leasing and mining on Indian tribal and allotted lands is beyond the scope of this statement. Language in parts of the Statement is broad enough to indicate it will have significance to all owners of lands underlain by coal--state, Indian, private, and holders of pre-existing leases.

Advisability of working to obtain EMARS coverage for Federally administered coal lands in Alaska should be considered, especially by the state and the Native regional corporations. It would help insure basic data

Review of EIS--Proposed Federal Coal Leasing Program
July 1, 1974
Page 2

aquisition, an increase in the proportion of Federal coal in the reserve category, and provide comprehensive pre-lease planning that could be a model and incentive for all coal owners. Possible disadvantages of inclusion under EMARS should also be evaluated. It might lead to submergence into an increasingly unwieldy system and put the Bureau of Land Management into an unduly restrictive position of top policy determination and control, from the point of view of non-Federal coal owners.

The Northern Alaska Coal Field is the only area in the Pacific Coast Coal Province described as having unique impacts. It forecasts serious adverse impacts on tundra, water supply, water quality, all forms of wildlife, and anadromous fish. The following sentences indicate the general tenor of this section:

> "Development will be many times more expensive than at lower lattitudes."
> "Minor disruptions will cause significant problems for fauna and flora."
> "Rehabilitation will be difficult with minimal success in the short run."
> "Long-lasting effects on erosion and stream sedimentation can be expected."

There is no mention of the present knowledge available to aid in forestalling and ameliorating adverse effects of operations in the Arctic or the rapidly expanding experience and research results accruing from petroleum, mining, and construction related activities in Russia, Greenland, Iceland, Canada, and Alaska.

No specific mention was noted of the probable effects of checkerboard ownership distribution, access complications, and other possible complications to Federal coal leasing in Alaska that will result from transfers of Federal land to the State of Alaska and to Native corporations under statehood and Alaska Native Land Claims Settlements. The estimated loss in Federal coal reserves and resources due to these land transfers was apparently not evaluated.

Tom Pittman

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

SEP 18 1974

Mr. Curt Berklund
Director Bureau of Land Management (723)
Department of the Interior
18th & C Streets, N.W.
Washington, D. C. 20240

Dear Mr. Berklund:

This is in response to your transmittal letter requesting the U. S. Atomic Energy Commission (AEC) to review the Department of the Interior Draft Environmental Impact Statement (DES 74-53) prepared by the Bureau of Land Management on the Proposed Federal Coal Leasing Program for the resumption of competitive leasing of Federal coal reserves from public lands in the Western United States.

Our review of the Statement indicates that the proposed program will not conflict with any known projects under the jurisdiction of the AEC Director of Regulation. However, as we have noted regarding other BLM statements, there may be possible conflict with planned AEC programs on coal gasification and suggest that AEC land use requirements in the Western United States public lands be always considered.

The discussion of the Nuclear Power Alternative (VIII-81 to VIII-89) should be updated. The AEC publication entitled "Nuclear Power Growth, 1974-2000" (WASH-1139 (74)) was updated in February 1974. Table I of the report estimates that the installed nuclear capacity within the United States will be 85,000-112,000 MWe by the year 1980; 231,000-275,000 MWe by 1985; 410,000-575,000 MWe by 1990; and 850,000-1,400,000 MWe by the year 2000. These estimates are somewhat lower than the previous estimates. The installed nuclear capacity within the U. S. as of June 30, 1974, was approximately 28,000 MWe.

Further information relating to the current resource base, production, and reserve potential of U_3O_8 is presented in the April 1973 AEC publication, WASH-1243, entitled "Nuclear Fuel Resource and Requirements." This publication, as well as the WASH-1139 (74), can be obtained from the AEC. We suggest that they be included in the references.

The status of the three fuel reprocessing plants (VIII-88) has changed. Of the two plants already constructed, neither is currently operating. The Nuclear Fuels Service plant, one which has been in service, has been closed for extensive modification. The General Electric Company, who has built the other at Morris, Illinois, has recently informed AEC that it does not want to commit the Midwest Fuel Recovery Plant (MFRP) to operations with irradiated fuel. Therefore, the MFRP should be excluded from any statistics regarding commercial fuel reprocessing plants. The third plant, Barnwell, is currently under construction and the application for the operating license is in the AEC Director of Regulation review process.

Mr. Curt Berklund - 2 -

We note that in the Energy Alternative Section there is no mention of recovery of natural gas by nuclear stimulation; however, we note that the Reference Appendix includes two AEC environmental statements on this technique. We feel that this method can contribute to the total energy supply by 1985 and a discussion of this alternate might be in order.

Although this document is intended to support the implementation of the Bureau of Land Management's Energy Minerals Allocation Recommendation System, it does not explore the possible effects of new coal recovery processes. Thus, the projections to the year 2000 could be somewhat in error, especially in the assumed mix of new coal mines required to supply U. S. energy needs. Specific comments related to the <u>in situ</u> technology are provided in the enclosed staff report.

We feel that the environmental aspects of the statement could be strengthened. While we acknowledge that CEQ Guidelines encourage simplicity, we feel that additional detail should be added which would focus on the aspects of ecosystem structure and function that are proposed to be disrupted and restored or sacrificed. For example, the important aspects of habitat (isolation, territoriality, food, cover, water quality, BOD, among others) seem appropriate for discussion in relation to mining activities. Soil formation, soil erosion, litter decomposition, mineral cycling, soil microbiota and soil fertility, and environmental factors on various topographical configurations seem appropriate for discussion of revegetation potential.

We feel that a possible weakness of the document is its attempt to develop a valid, generic, national assessment of a broad range of impacts that will be felt throughout a highly diverse aggregate of biophysical regions. The impact statement is cast largely in terms of broad ecological "provinces" and would be considerably improved by some specifics as to impacts on representative sites within the provinces. We feel that the discussion of esthetic aspects is valuable. However, perhaps more attention could be directed to what might be termed "auxiliary" features of development, such as new towns, and transportation.

We feel that a general editorial comment is in order to assist in the review process. The use in the text of specific numerical references to the reference documentation would be helpful.

Mr. Curt Berklund - 3 -

Comments are also provided in the enclosed staff report for your additional consideration in the preparation of the final statement.

We appreciate the opportunity to review and comment on this draft statement and request that in the future six copies of draft statements be sent to this office for the review process.

Sincerely,

W. H. Pennington
W. H. Pennington
Assessments and Coordination
Officer
Division of Biomedical and
Environmental Research

Enclosure:
Staff Report

cc: Council on Environmental Quality (5)

AEC STAFF REPORT
COMMENTS ON THE BUREAU OF LAND MANAGEMENT
DRAFT ENVIRONMENTAL IMPACT STATEMENT
Proposed Federal Coal Leasing Program (DES 74-53)

1. <u>General Comments</u>

The impact statement clearly represents a considerable effort for which the authors should be commended, but it is necessary to question whether the objective of this document was to justify a Federal Coal Leasing Program or to detail and assess the environmental impacts of alternative lease development practices in a cost-effective manner that could help outline a federal leasing program. It is not clear than an authentic <u>national</u> environmental impact statement can be written concerning a program that is actually <u>multi-regional</u> in character. While a considerable amount of the background data necessary to assemble such a statement does exist, it appears that there was insufficient time to acquire and structure this information on a regional scale and to draw appropriate conclusions with regard to the proposed course of action.

In general, the narrative lacks substantial documentation. It tends to be very subjective in places and abounds with what appears to be unsupported value judgments. For example:

Page 44, pt. II, "Current Federal coal leases are not in areas of outstanding human interest;" p. 116, pt. II, "Rural localities are notable for their lower rate of acceptance of new social norms and modes." It is necessary to ask - "interest" to whom, and by whose standards; "lower" than what?

While the report is fairly well regionalized in terms of physiographic divisions, it does not contain sufficient coal resource, regional and cartographic information to establish an adequate regional perspective. For example, many important physiographic features are discussed without being located cartographically.

While human values are difficult to evaluate, a more objective approach to the assessment of aesthetic impacts would be more appropriate. The sections on human resources appear to be rather subjective and opinionated.

The purpose of Volume I is to describe in a "general" way the biogeophysical environment of federal coal reserves, to discuss the en ronmental impacts of

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past exploration, development, production and transportation of coal resources managed by the Federal agencies, and to indicate methods of restoring land value. (1-6)

Section II of Volume I provides general descriptions of the environment and land use in each of the three primary geographic areas. Most of the land in the Pacific Northwest and Rocky Mountain areas is rural in character (grazing, crops, forest) with significant outdoor recreational activity (65% in Rocky Mountain area). The Northern Great Plains province is primarily a vast expanse of rolling grasslands, much of which supports native vegetation. Much of this is used for grazing, and there are extensive croplands distributed throughout the region. Land dedicated to recreational purposes is minimal in this region. Water resource management for power production and mineral extraction is a significant issue in both the Rocky Mountain and Northern Great Plains region. Erosion is a particular problem in the Rocky Mountain area.

The development of the extensive coal deposits of the Western provinces will clearly require extensive planning and analysis. One of the major issues will certainly be the disruption of aesthetically attractive recreational and scenic areas. The final statement should provide some indication of how such issues are to be resolved. For example, suitability analyses could be conducted and regions most (or least) suited for coal production based on indices and factors other than the mere availability of coal could be identified. The report does admit that the best way to mitigate land use impacts is to minimize mining, and if mining must be undertaken, it should be conducted on lands of least societal value. However, no indications of the criteria or methods for making these decisions are provided.

The discussion of land use potential following mining and when this potential can be achieved, is minimal and should be expanded (II-14). Some indication of the probable timing of land rehabilitation efforts and the expected end use of the land should be provided for each area. The length of time that the land is disturbed and the rate at which disturbed land can be reclaimed is an important aspect of the decision to undertake mining operations. In some cases, it may be possible to enhance the value of the land for specific uses after mining. These cases should be identified. An

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analysis of the probable timing of mined land reclamation could be overlaid with the suitability analysis mentioned above to yield a more complete set of criteria on which to base coal resource development decisions.

The report properly acknowledges the need for preplanning the mining activity, pre-mining site surveys, reclamation planning, etc. All of these are essential prerequisites to mine siting and the granting of leases.

While the report states that current disruption of prior land uses due to mining is less than .001% per year, no forecasts have been made regarding how much land might be disturbed in future years should production be increased to anticipated levels. This forecast should be prepared.

The report fails to place sufficient emphasis on the potential for land use conflicts associated with surface mining and on the identification of areas where surface mining could be conducted with minimal environmental impact. As previously stated, a major shortcoming of the impact statement is the lack of quantitative analysis to support any of the conclusions reached. For example, the conclusion that:

> "...carefully located and planned extraction of Federal coal, with accompanying rehabilitation, generally produces values in excess of the immediate loss of non-coal values plus the long-term loss in productivity of the rehabilitated land." (p. VI-14)

is made without any supporting evidence.

Although many of the socioeconomic impacts of leasing the Federal coal land are extremely difficult to quantify, the statement would be improved if information is provided regarding the number of people effected and their socioeconomic and demographic profiles; the locations of population centers; levels and types of employment; personal incomes; the types, magnitudes and distribution of terrestrial and aquatic ecosystems; the living and migration characteristics of indigenous wildlife; the extent and location of vegetation including timber and croplands; the extent and location of grazing lands, waterways, prairies, deserts, etc.; and the proximity of these "inventories" of vulnerable systems to potential coal mining activities. Without this basic information, it is nearly impossible to assess the biogeophysical and socio-economic impact of developing these coal fields. Additional information required is estimates of the public health and environmental consequences such as ambient water quality, air quality, potential wildlife and fish [illegible]ls, and land

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degradation. This information should be developed for both coal mining and any related activities such as transportation, power generation and coal conversion.

Volume II addresses some of the potential impacts of coal mining. However, like Volume I, it is interspersed with subjective opinion and generally lacks sound, factual data base which is necessary to support decision-making. Many of the questions posed in Volume I remain unanswered in Volume II. The section that treats the rehabilitation of disturbed areas fails to identify the areas (size in acres or square miles) already affected or those which are presently vulnerable in each region.

Although it is suggested that mining be prohibited in areas of "outstanding beauty" (IV, p. 56), no practical definitions of such areas are provided, nor are there maps showing their distribution. Likewise, "areas of uninteresting relief" (VI, p. 17) are ill defined and unmapped. Such phrases will provide mining officials and reclamation personnel little help in determining policy.

This volume does address many of the more significant problems associated with the reclamation of surface mined land. For example, reclamation can be accomplished in the East, where precipitation is adequate, providing erosion and acid forming materials are controlled, but much is still unknown about the Western coal fields. This is particularly the case with regard to areas characterized by relatively low levels of precipitation (6-10 inches annually). It is evident that a great deal of work needs to be done in order to draw meaningful conclusions about these areas. Very large amounts of data must be generated and evaluated before a comprehensive analysis of the environmental impacts of mining in these regions can be attempted.

The costs and effectiveness of various "mitigation" schemes should be evaluated to justify appropriate environmental control plans and to evaluate the economic potential of developing the Federal coal resources. Without this kind of information, it is very difficult to substantiate such statements as:

> "Proper administration of Federal coal-drilling by the Federal land-managing agency and the Geological Survey will generally leave few unmitigated environmental impacts." (p. V-17)

On the other hand, the report does provide some quantitative estimates of the economic benefits of developing the land. These incl[illegible]s the employment generated,

- 5 -

the capital investment required, and the value of the coal to be mined. These estimates also indicate that additional benefits might include improvements in the balance of payments, provision of additional supplies of coking coal for Western steel mills, the financing of schools, cultural activities, etc., through the tax revenues generated by the coal mining.

Although such statements are true, care should be exercised to ensure that the magnitude of these benefits is correctly evaluated. For example, the dollar value of the employment generated, the investments made, and the improvement in the tax base are all incorporated in the estimate of the gross value of the coal mined. The former estimates reflect the distribution of these benefits to various special interest groups. It is therefore inappropriate to imply that all of these economic consequences can be cumulated to obtain an estimate of the total benefits derived from mining coal in these areas.

In the discussion of adverse effects, the statement contains a number of seemingly inconsistent statements. For example, when discussing the effects of projected coal mining activities, it is stated that these effects are <u>temporary</u> because the lands will eventually be returned to other uses. However, when discussing the advantages of developing the coal resources, <u>permanent</u> employment opportunities are described. Another inconsistency in the analysis relates to social impacts. Considerable emphasis was placed on the essentially conservative character of the people who live in the coal resource areas. These populations apparently do not readily accept change. However, while discussing the advantages of the coal development program, social benefits are cited which would cause considerable social and political changes in these regions. Certainly the status quo should not be preserved for its own sake, but the benefits mentioned may accrue to new populations and not to the existing residents.

A separate chapter might be added to identify cost-benefit considerations associated with possible alternatives to the proposed course of action.

In summary, this document demonstrates the extreme difficulty of developing a generic national environmental impact statement for an aggregate group of large, diversified regional areas. It would be far more appropriate to make such evaluations on a case-by-case, or at least, region-by-region basis

- 6 -

The authors recognize this when they state:

"The precise nature of impacts and their dollar values can be determined only when a specific mining proposal is precisely examined." (p. VI-12)

Finally, the environmental impact statement is inconclusive. There is no cost-benefit consideration of alternatives. No conclusions are drawn. No opinions are given as to where and under what conditions leasing might or might not be permitted in the public interest.

Without discounting the considerable effort that was evidently expended to prepare this report, and recognizing the magnitude of the difficulties involved, we suggest that it falls far short of its purpose, and that any future proposals to lease Federal coal lands will be vulnerable to attack on environmental and conservationist grounds unless a more substantial case can be made.

2. Specific comments relating to the <u>in situ</u> coal gasification program:

pp. I-29-35 - The assumptions for energy requirements given here could be modified if <u>in situ</u> gasification were vigorously pursued.

pp. I-72 - Coal gasification is discussed here, but the possible impact of <u>in situ</u> technology is not discussed, especially with respect to the number of surface gasification plants required by the year 2000.

pp. I-118,119 - Again, existing gasification technology is discussed, but no indication of the potential of <u>in situ</u> processes is given.

pp. I-124 - A discussion of rehabilitation should mention <u>in situ</u>, since the extent of rehabilitation required for this technology should be less than that for strip mines.

pp. I-175 - The Bureau of Mines, Hanna, Wyoming <u>in situ</u> experiment is described here: a description of the AEC <u>in situ</u> experiment and the possible sites of interest to this technology should be included.

pp. I-199 - It is noted here that the Bureau of Mines predicts 36 coal gasification plants will be operating by 1985. The effect of a vigorous <u>in situ</u> program on this projection should be indicated.

pp. I-202 - Lead times for coal resource utilization technologies are given here; <u>in situ</u> gasification should be inclu' 'd.

- 7 -

pp. I-203 - Recovery of thick bed coal resources is discussed here; the applicability of <u>in situ</u> gasification to these resources should be emphasized.

pp. III-12-68 - A number of sections of Chapter III ("Environmental Impacts") 74-79 should discuss the characteristics of <u>in situ</u> recovery along with those of deep mines and surface mines.

pp. III-73-74 - This discussion of "Potential Extractive Techniques" should definitely present the <u>in situ</u> process as a potentially important technique; this section would be a good place to present the details of the process.

pp. IV-20-70 - This part of Chapter IV ("Measures to Mitigate Environmental Impacts") should discuss the potential of <u>in situ</u> technology as an alternate method of resource recovery.

Chapters V, VI, and VII - All should discuss possible effects of <u>in situ</u> technology.

pp. VIII-56-59 - "Alternatives" discussion of synthetic oil and gas appears to be overly brief and does not include <u>in situ</u> technology. This would be a good place to describe the process and its consequences in some detail.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR, FISH AND WILDLIFE SERVICE

In Reply Refer To:
FWS/CR

SEP 9 1974

Memorandum

To: Director, Bureau of Land Management

From: Acting Associate Director, Fish and Wildlife Service

Subject: Review of Draft Environmental Impact Statement on Proposed Federal Coal Leasing Program.

Attached are our comments on the subject draft environmental impact statement.

Enclosure

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

General Comments

The statement reads very well and is unusually frank in its treatment of adverse effects associated with both surface and underground mining. It is informative, comprehensive, and has excellent photographs. The major problem we encountered was the lack of clarity as to the scope of this particular ES. We are uncertain whether additional statements will be written as each lease area is opened, or whether this rather generalized document is intended to serve as the ES for the actual mining phases of the lease program. This point should be discussed early in the statement.

General Suggestions include:

Deleting "etc" from the text.

Considering an addition to the appendix that would give common and scientific names for the plants and animals enumerated in the text. This might be done by coal provinces, and the lists checked by knowledgeable people for the given province.

Considering inclusion of a map showing major physiographic provinces of North American (cf Fenneman) to accompany the map showing coal provinces on page II-47.

Standardizing way of citing authorities in the text.

Checking citations for listing in REFERENCES.

Considering more complete documentation of some statements appearing in the text. (Example: page III-62, last two sentences first paragraph.)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Washington, D. C. 20250

8400

Director (383)
Division of Upland Minerals
Bureau of Land Management
U. S. Department of the Interior
Washington, D. C. 20240

Dear Sir:

Enclosed are Forest Service comments on the draft environmental impact statements for the proposed Federal Coal Leasing Program. We apologize for the late submission. We appreciate your indicated willingness to accept them at this late date.

The Federal Coal Leasing Program will have significant impacts on our Nation's economy and upon the natural environment. It will influence future patterns of development of the various sources of energy and the rapidity with which we respond to the present energy crisis. It will have major impacts on the future opportunities for multiple-use management of the Federal lands involved.

The draft statement is an impressive document with considerable candor in its assessment of the environmental impacts of the program.

Sincerely,

Acting Deputy Chief

Enclosure

Forest Service Comments on the Draft
Environmental Impact Statement Proposed
Federal Coal Leasing Program

1. We believe a procedure should be developed for cooperation between the Federal agencies concerned. The procedure plan could be detailed in another document, but it should be emphasized in the EIS.

2. The coal leasing program would be placed in better perspective if an estimate of the amount of land to be disturbed at any one time were compared to the total area to be surface mined and total area under lain by coal.

3. The magnitude and duration of environmental impacts will depend, to some degree, on the success of research, development, and application programs. Reference should be made to the Northern Great Plains Resources Program (NGPRP) and Surface Environment and Mineral (SEAM) programs. This could be done by relating their programs to resumes of:

A. Mining activities that create adverse impacts.

B. The most common adverse impacts associated with strip mining.

C. Adverse impacts that are typical of certain minerals associated with coal and specific geographic locations.

4. I - 1a and 2: The EMARS program appears to be based on two major criteria - the rate at which Federal coal should enter the market and the most favorable rehabilitation potential. We believe EMARS allocations should weigh all resource values. There is no criteria established for arriving at priorities and too much weight appears to be placed on the use of coal over other fuels.

2

5. I -3: Multiple-use planning does not seem to be integrated into the yearly laying out of the optimum coal lease sales. The role of multiple-use planning in coal leasing should be clearly spelled out.

6. I -4: Definitions are needed for one year leasing schedule and the tentative 4-year leasing schedule.

The first paragraph points out that BLM will prepare environmental impact evaluations as afforded by their land use planning system after proposing leasing schedules. This seems a reversal of the system where EIS are completed before the action.

7. I -7: A comprehensive Federal Coal leasing program for the entire United States should also consider the impact of coal from sources other than those coal deposits owned by the Federal government.

8. I -11: The statement "Action programs adequate to meet critical energy needs must proceed further and faster than many would like, and certainly far in advance of our ability to completely analyze all of the complex cause and effect relationships that are involved." seems to pave the way for a less than acceptable evaluation of all the resources prior to large scale coal leasing.

9. I -77(J.2.): A table summarizing State bonding requirements would be supportive.

10. III: The chapter does not include discussion of the environmental impact of coal-fired generating plants. However, it does provide pictures, I-36 and V-27, showing air pollution resulting from such plants, and also slightly discusses mitigating measures to lessen the impact of

3

generating plants on pages IV-69 and 70. Power plant construction and operation with ancillary transmission lines would have considerable impact on a number of environmental factors --soil, water, vegetation, wildlife, esthetics, and air; all of which should be pointed out in Chapter III.

11. III -30: This section on impacts common to all areas should include a separate paragraph on the socio-economic impacts generated by rapid increase in population, lack of community services, etc.

12. II -71, item (8): This item should identify adverse impacts of power transmission lines such as noise, interference to radio and TV signals, production of ozone, removal of area cleared from timber production; effects of livestock, wildlife, and recreation use.

13. IV -19, item (6): Exploration drilling by the Federal government will not necessarily satisfy potential lessees. The locations of the drill holes may not be mutually agreeable and the drill hole logs are not likely to be interpreted exactly the same. Some potential lessees would still want to drill additional holes for their own satisfaction.

14. VIII -1, item A: A statement about the adverse impact of eliminating Federal land coal production on the national economy would be appropriate in the 1st paragraph.

15. VIII -3: The paragraph under "cost" should acknowledge that an effective method used during the energy crisis in November-December 1973 was to baseload midwest power plants fueled with low-sulfur coal and "wheel" electricity via power grids to east coast grids, thus relieving pressure on oil-fired east coast plants using imported crude oil.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Washington, D. C. 20250

JUL 4 1974

SUBJECT: EVT - Comments - Environmental Impact Statement
Proposed Federal Coal Leasing Program, BLM

TO: Curt Berklund, Director
Bureau of Land Management
Department of the Interior

The two voluminous reports comprising the environmental impact statement for proposed Federal Coal Leasing Programs contain much information of interest. There is considerable narrative, however, on topics that are not intimately related to impacts on the environment. The first volume, about 450 pages, includes the history of Federal Coal Leasing, occurrences of federal coal, coal reserves and resources, definition of coal, coal formation, classification of coal, etc. There are also descriptions of geology, topography, climate and air, hydrology, soils, vegetation, wildlife, land uses, etc., for six "coal provinces." These are descriptions of the environment in its natural condition only. There are no references in this volume relating to impacts on the environment that may occur when coal is mined.

Volume 2 delves more specifically into some of the impacts that may accrue from coal strip mining. But there is also much extraneous material in this volume such as the fate of organisms during mining operations, research that is underway, and techniques for establishing vegetation. The portions of the report that relate specifically to environmental impacts are well done.

Certain impacts were not clearly defined such as the effects an influx of new people will have on resources in and around new communities. There wasn't any mention of the ability of local communities to provide government services needed for water, power, police protection, etc. Water quantity and quality were not sufficiently covered, particularly as related to coal processing operations.

We are returning herewith Volumes 1 and 2 of the Draft Environmental Impact Statement.

Kenneth E. Grant

Kenneth E. Grant
Administrator

Enclosure

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 2440, Casper, Wyoming 82601

June 18, 1974

Director
Bureau of Land Management (720
Washington, D. C. 20240

Dear Sir:

We have reviewed the Department of Interior's draft environmental impact statement on public land coal leasing.

We noticed what appeared to be errors regarding specific soils in Wyoming. On page II-76 and II-77, Dunlap is no longer a recognized soil series. Also, all of the soil series listed (except for Chipeta and Billings) would not occur in the Big Horn and Wind River regions. They are found in the Powder River region of northeastern Wyoming.

Limitations under Midway, page II-76, indicate "secure compaction hazard." It should be "severe compaction hazard."

The only comment we were able to find on the importance of a basic inventory such as the soil survey was on page II-85 where it states "A detailed on-site soil survey must be made before the total resource is known." It appears to us that the statement should point out in more detail how the soil survey would provide much information needed to help in reclaiming disturbed spoil areas.

Sincerely yours,

Blaine D. Halliday

Blaine D. Halliday
State Conservationist

cc:
K. E. Grant, Administrator
K. L Williams, Director, WRTSC

JOHN L. McCLELLAN, ARK., CHAIRMAN
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LAWTON CHILES, FLA.

JAMES R. CALLOWAY
CHIEF COUNSEL AND STAFF DIRECTOR

United States Senate
COMMITTEE ON APPROPRIATIONS
WASHINGTON, D.C. 20510

June 26, 1974

The Honorahle Curt Berklund
Director, Bureau of Land Management
Department of Interior Building
Washington, D. C. 20240

Dear Mr. Berklund:

The enclosed letter sent me by the Speaker of the West Virginia House of Delegates and the Chairman of the West Virginia Senate Mines and Mining Committee, with its enclosure, is submitted for appropriate attention.

You will note that the letter transmits the official commentary of the West Virginia Legislature on the draft report prepared for your office, entitled "Environmental Impact Statement--Proposed Federal Coal Leasing Program." I hope that careful consideration will be given to the points made in this analysis of a report which could be quite damaging to my State of West Virginia.

With kind regards,

Sincerely yours,

Robert C. Byrd
Robert C. Byrd
U. S. Senator

RCB:yjm
Enclosure

WEST VIRGINIA LEGISLATURE
CHARLESTON 25305

W. T. BROTHERTON JR., PRESIDENT
STATE SENATE
1220 KANAWHA VALLEY BUILDING
CHARLESTON 25301

LEWIS N. McMANUS, SPEAKER
HOUSE OF DELEGATES
P. O. BOX 1818
BECKLEY 25801

June 25, 1974

The Honorable Robert C. Byrd
Assistant Majority Leader
United States Senate
Washington, DC 20010

Dear Senator Byrd:

As you know, the Bureau of Land Management, U. S. Department of the Interior, recently published its two-volume draft report entitled "Environmental Impact Statement---Proposal Federal Coal Leasing Program."

This report is erroneous, one-sided, flagrantly opinionated, and full of mis-statements or misleading statements in developing the strongest possible case for the use of low-sulfur Western coal (most of which is situated under Federally-controlled lands), and virtually ignores the abundant reserves of low-sulfur coal found in West Virginia and other Eastern and Appalachian states.

In brief, it does a grave disservice to the State of West Virginia, which could be translated into severe economic problems for our people and the coal industry of our State. As co-chairman of an interim committee of the Legislature concerned with the study of our coal resources, we feel we cannot let this radically-biased document go to final printing without comment.

Our research analyst, Norman Kilpatrick, has done a superb job of preparing arguments and exceptions to the draft report, and we should like to request your assistance in transmitting his comments, along with a copy of this letter, to the Honorable Curt Berklund, director of the Bureau of Land Management, U. S. Department of the Interior, as a formal comment and protest.

Such comments are due on or before June 28, and we would appreciate your assistance in providing this dissent to Mr. Berklund on or before this date. May we thank you in advance for your assistance in this matter, and commend Mr. Kilpatrick's material to you for your personal examination of how this Federal agency has distorted and misrepresented the truth in quest of reaching the conclusion which, apparently, it had pre-determined.

With warmest personal regards,

Sincerely,

Lewis N. McManus
LEWIS N. McMANUS
Speaker, House of Delegates

Alan L. Susman
ALAN L. SUSMAN
West Virginia State Senate

LNM:C:sah
Enclosures

Comments On United States Department of the Interior
Des 74 Draft
Environmental Impact Statement Proposed Federal Coal Leasing Program
By: Speaker Lewis N. McManus-West Virginia Legislature
Senator Alan L. Susman-Chairman-Mines & Mining Committee
West Virginia State Senate
Co-Chairmen-West Virginia Coal Study

I-38; These photos and captions are totally inaccurate. The majority of Appalachian coal production is not "high sulphur" (over 2%) as stated. In 1964 the Bureau of Mines estimated (#1C-8312), only 17 per cent of Appalachian production was high sulfur coal. 1973 saw a majority of West Virginia's, Virginia's, and Eastern Kentucky's, production from low and medium sulfur seams.

I-104; The Appalachian photo appears to be of an orphan surface mine and gives no evidence of the environmentally sounder methods of mining on steep slopes now used in Pennsylvania and parts of West Virginia. This tends to make Western strip mining appear "better" than surface mining of low sulfur coal in Appalachia.

I-105, I-106, I-108, I-109; All these drawings show environmentally unsound ways to contour surface mine, with spoil over the side and flat areas where water can seep into the "fill" and pick up acid materials. It is incompetent for any 1974 report to fail to show the workable and environmentally sound "lateral movement" and "modified block cut" techniques of Pennsylvania and West Virginia which avoid the need to put spoil over the side of a mountain, on slopes up to 40 degrees!

III-40; I fail to see what photos of Hanna Coal Company's "showcase" Sallie Buffalo Park, in a high rainfall area and with a limestone overburden, or some old landslides from West Virginia contour stripping illustrate. It seems to suggest reclamation on flat areas is great, and Appalachian low sulfur stripping is hopelessly bad, which used to be true but does not have

page 2

to be.

III-78; These photos designed to show Appalachia as a depressed area, to be written off, have no relationship to the caption, concerning exploration and construction of new surface mining operations.

IV-3; These photos from high rainfall - limestone overburden Ohio, have no relationship to the climate and geology of the Northern Great Plains. Crown vetch will not grow well in Montana, Wyoming, New Mexico, Arizona, etc., because of the lack of rain. Its success in North Dakota and South Dakota may be greater but will still be limited since it is not a plains type plant.

IV-45; The Cadiz photo in an area with 40 - 50 inches of rain does not mention that even there it takes more acres to raise cattle on natural graze than it did before mining.

IV-51; Cadiz, Ohio is in no way similar to the Northern Great Plains except that mining also disrupted the water table, which they don't mention.

In general, the photos give a completely negative image of Appalachia and its coal, the area with larger low sulfur reserves than those that can be stripped from the Northern Great Plains. They stress damage to wild animals, (which have little public support) and do not stress damage to wheat cattle and sheep, which most Americans will show a fairly high concern for, since they pay for them at the store. The constant implication that Great Plains reclamation will look like Cadiz, Ohio, is grossly false and misleading.

Chapter #2-F Eastern Coal Province

Page 215 provides an estimate of 122,000,000,000 tons of coal remaining in Appalachia "under 0 to 1,000 feet of overburden". This is a tricky effort

page 3

to underestimate the reserves of Appalachian low sulfur coal. In 1966, De Carlo, Sheridan & Murphy estimated 91 billion, 104 million tons of low sulfur coal resources in Appalachian Pennsylvania, West Virginia, Virginia, Eastern Kentucky, Tennessee and Alabama. In 1967 Price and Latimer estimated over 46 billion tons of low sulfur (1% or less) coal reserves were left in West Virginia alone, distributed among 20 major seams. Like all conventional estimates of reserves, these studies calculated reserves down to 3,000 feet. This is obviously more realistic than the 1,000 foot limit, as well, since Alabama Power Company is obtaining low sulfur coal from 3 new deep mines some 1,900 feet below the surface of the ground. The arbitrary limitation of 1000 for coal reserves is an effort to make the strippable low sulfur coal reserves of the West look more significant compared to the low sulfur coal reserves of the Appalachian area. A similar method to maximize the apparent size of low sulfur coal reserves in the West and minimize those of the Appalachian area can be found in the refusal of this document to compare Appalachian and strippable Western coal on a B. T. U. basis and to adjust the (in situ) sulfur level of Western strippable coal upward to its true level when its water content is removed. (see "Low Sulfur Coal: A Revision of Reserve and Supply Estimates" by Michael Rieber, and "Facts about Coal in the U. S." by John McCormick) Appalachian low sulfur coal may, in fact, have almost 5 times as much heat value as the low sulfur coal that can be stripped in the Northern Great Plains, which coal is the basis for the proposed Federal coal leasing program. The "Facts" study under-estimates the B.T.U. value of Eastern low sulfur coal by calculating 11,500 B.T.U.'s per pound. Appalachian low sulfur coals actually have up to 15,000 B.T.U.'s per pound (See "Coal - Geology Bulletin #1-1974" by West Virginia Geological & Economic Survey.) and the 13,100 B.T.U. figure on page #1 of the "Facts" study is a good average for such coals.

page 4

11-221 -9A, 9B, 9C, & 9D; These sections sound like something taken directly from a book like Yesterday's People. They are somewhat inaccurate and greatly out of date. In no Appalachian state is coal employing anything like 25% of the state's industrial workers, yet almost all Appalachians in the coal regions are part of a cash economy, not "hunting and subsistence farming", if employed at any occupation. Especially since the rise of television and regional highway systems, Appalachians are generally no different than any other Americans who value their land and region, as do Mid-West farmers, "down Maine" residents and Southerners, white and black.

Whoever wrote this section knows little about Appalachia for he locates Mammoth Cave National Park in it, although Mammoth Cave is actually in the Interior Province coal fields and has been effected by strip mine siltation as a result.

Chapter #8 - Alternatives

The consideration of a "no-go" policy of Federal coal leasing contained in the Draft is totally inadequate. In fact, a "no lease" policy would actually only harm those coal and energy companies with specific plans to exploit such coal. This is so because this section omits three major sources of low sulfur coal which obviously will prosper greatly without Federal coal competition. These are: Western coal owned by the Indian nations, Western coal owned privately and Appalachia's huge low sulfur coal reserves. In the face of these alternatives the statement, "...this report finds no measures available which could stimulate an equivalent production potential of alternative energy sources..." is totally incompetent!

The utilization of Federal low sulfur coal in place of Appalachian low sulfur coal, contrary to the statement on #8-2, will decrease employment, reduce the gross national produce and increase the cost of low sulfur fuel to consumers east of the Mississippi. This is because the proposed mining

page 5

of Federal low sulfur coal will involve the use of giant strip mining draglines and shovels, the use of excessive amounts of diesel fuel to transport much of this coal east of the Mississippi, at a total cost in excess of that involved in Appalachian low sulfur coal, under long term contract, that could be mined and shipped to utilities and industrial users in the Mid-west, South and Appalachian areas (on a B.T.U. basis). This is so because Eastern low sulfur deep mined coal is a labor intensive industry while Western surface mining of low sulfur coal is an energy using industry. Taking the annual estimated 22 1/2 million tons of low sulfur coal slated to pass east of the Mississippi from Federal surface mines, according to the Bureau of Mines Publication "Assessment of the Impact of Air Quality Requirements on Coal In 1975, 1977 and 1980," and after adjusting for B.T.U., we can estimate that this coal will displace some 15,000,000 tons of Appalachian and Mid-western coal. This does not, of course, count the displacement of Eastern coal that will be caused by similar shipments into the Mid-west and Appalachian coal market areas, from Indian and private lands in the Northern Great Plains, Colorado, and Utah. For example the "1973 Annual Report" of American Electric Power suggests that firm will ship some 20,000,000 tons of privately owned coal as far East as Moundsville, West Virginia, plus some 8,300,000 tons of Federal coal, cited by the Bureau of Mines. 1973 statistics from the West Virginia Department of Mines indicate that typically it requires a labor force of approximately 330 men to mine 1,000,000 tons of low sulfur coal by deep mining methods and approximately 100 men to mine 1,000,000 tons of low sulfur coal by surface mining methods. Assuming some 20% of the 15,000,000 tons to be displaced would have been surface mined in Central Appalachia (roughly the percentage of West Virginia's production now surface mined) and 12,000,000 tons deep mined, the 22,000,000 tons of Federal coal projected to move east of the Mississippi in the near future (by the Bureau of Mines) will mean a direct job loss of 4200 jobs and (using a 1X3 multiplier) an additional

page 6

job loss of 12,600 supporting jobs. Failure of the Draft to include projections of this sort are a major deficiency of the document. To support this criticism it should be noted that the 1974 Keystone Coal Industry Manual indicates low sulfur coal from Virginia, Eastern Kentucky and West Virginia is currently utilized for industrial, coking, and utility use as far away as Houston, Texas; Milwaukee, Wisconsin; Chicago, Illinois; Detroit, Michigan; Indianapolis, Indiana; and Ontario, Canada. Coal from the Appalachian low sulfur field can reach Chicago or Houston with inexpensive barge transport from Eastern Kentucky or Central West Virginia due to the availability of navigable waterways such as the Kanawha and Kentucky rivers which connect to the Ohio - Mississippi - Illinois - Intercoastal Waterway systems.

VIII-3; The discussion of the high transportation costs of shipping Western low sulfur coal to East Coast utilities is absurd. It is a continuation of efforts by the Bureau of Mines to rationalize all-out stripping of Federal coal lands, as suggested in IC-8614, "Comparative Transportation Costs of Supplying Low - Sulfur Fuels to Mid-western and Eastern Domestic Energy Markets." This study and the Draft, cleverly omit all serious mention of Eastern medium and low sulfur coal, which now does supply some East Coast electric generating plants and could supply even more, if offered the right prices and terms of contract. It is an insult to the intelligence of the American public for this Draft to imply or suggest Western coal is the only coal that could replace gas or oil at power plants. The Bureau of Mines, in defending this approach in Ic #8614, have indicated little Eastern low sulfur coal was owned in large blocks, that little expansion capacity exists in Appalachia, and that the cost of low sulfur coal from Appalachia was "too great." All these assumptions, unexpressed but implied in the Draft, are totally false.

Pages 8-4 and 8-5 avoid mentioning the availability of low sulfur coal near East Coast and Mid-west utilities. This is especially important on

page 7

page 8-7 where the totally inaccurate statement is made, "mine-mouth plants in remote Eastern areas are an example, since they are faced with the geographic dilemma of high transportation costs..." First, air pollution standards will allow the high B.T.U. Eastern low sulfur coals (13,000 - 15,000 B.T.U.'s per pound) to have an average up to just under 1% sulfur, since the 0.7% average standard is generally for a 12,000 B.T.U. coal. With his in mind, and also considering that some coal burned at the utilities effected by the standards can use higher sulfur coal if it is cleaned before burning, or blended with low sulfur coal, the quoted section of the Draft is absurd. No "mine-mouth plants" in the East are far from the low sulfur coal fields of West Virginia, Kentucky, Virginia, or Alabama. Such plants are located in Western Pennsylvania, Eastern Ohio and Northern West Virginia. Most are situated so low sulfur coal can reach them easily, by water. Kammer, Mitchell, John Gavin, Muskingum River, Sammis, Colfax, Phillips, Fort Martin, Elrama, Burger and Kyger Creek are examples. Others would require only relatively short rail trips to receive Eastern low sulfur coal. Any implications to the contrary are totally false and inaccurate.

One major omission from the Draft, in the section on "Substitutability in Sectors of the Economy Other Than Power Generations" is the impact on the use of fuel oil for transportation of Western coal east and south, if massive Federal coal leasing is allowed. It has been estimated that as much as 15% of the national supply of diesel fuel will be consumed transporting Western coal, if Federal and coal industry expansion plans are carried out, by 1980. This will divert this fuel from other sectors of the economy and possibly make use of diesel equipment in deep mines more difficult. Underground diesel equipment is considered by some coal industry members to be more productive than current underground electrical equipment, it should be pointed out. Failure to discuss this issue is clearly a deficiency of the Draft.

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The discussion of oil imports omits an important alternative, which makes this section inadequate (but consistent with earlier omissions of Eastern low sulfur coal from all consideration of alternatives to massive stripping of Federal coal in the West). That alternative is to decrease the need for foreign oil imports and eliminate the need for Polish and South African coal imports (which the Draft omits mention of) by encouraging conversion of all East Coast power plants (that can do so) to low and medium sulfur coal. Such conversion can be facilitated by those utilities providing "cost plus" long term contracts, possibly with financing of the mine provided by the utility, to allow for the opening of new Eastern coal mines. This has reportedly been done recently by Eastern utilities such as Duke Power Company, Ontario Hydro and Appalachian Power Company. This could significantly reduce the level of oil imports needed by the United States, especially if new East Coast power plants also obtain American coal instead of foreign fuels. The economic impact of opening new coal mines in Appalachia, instead of importing foreign coal, gas, and oil to east Coast utilities is, of course, also omitted from the Draft.

The section on coal gasification neglects a number of important points. One is that in recent years both Federal and private funds have been directed toward techniques and pilot projects designed to gasify the lignite and subbituminous coal of the Northern Great Plains, not Eastern high sulfur bituminous coal. The implication that Federal coal leasing must push forward so as not to disrupt Federal gasification projects ignores the fact that gasification projects located in the Northern Great Plains, far from the nation's population centers, and intended to use a relatively low sulfur fuel, make no sense, except for the few owners of this coal. It would be far sounder, environmentally, from an energy utilization position and from an economic view, for the Federal Government to drop all or most of its Western gasification plans and extend, instead, money and technology on gasification of

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high sulfur bituminous coal, such as that found in the Mid-west, Pennsylvania and Northern West Virginia. Research efforts by Old Ben Coal Company are already underway to gasify the huge high sulfur bituminous deposits of the Mid-west into an environmentally acceptable fuel. These deposits are estimated to contain over 330 billion tons of coal resources, as of January 1, 1965, according to De Carlo, Sheridan, and Murphy in I.C. #8312- "Sulfur Content of United States Coals." They, not the relatively low sulfur strippable reserves of Federal coal, need gasification to promote their greatest utilization. Use of such coal is more economical than gasification of Western coal, due to its location near the great population centers of the Mid-west and the East Coast. The failure to discuss this matter is a significant shortcoming of this Draft, since this is obviously a significant alternative to gasification of Federally owned coal.

Another facet of the coal gasification issue not examined in the Draft, because it would detract from the "need" for Federal stripped coal, is the potential for commercial use of methane gas from Eastern bituminous coal. The Bureau of Mines has estimated that 227,000,000 cubic feet of this natural gas escapes from Eastern coal seams every day. A Vice President of Eastern Associated Coal Corporation states that, as in Europe, the technology to extract methane for commercial use is here, today, and only minor activities are needed to see methane utilized as a sulfur-free fuel on a relatively large scale. Of course, methane extraction, from above ground, or from the coal face, is generally practical only in deep mine situations. Commercial use of methane gas would increase Eastern deep mine safety and lower its costs considerably. Further, this gas will be available in locations near major population and agricultural areas needing natural gas, and possessing existing natural gas pipe lines and storage areas.

I.C. #8621, "Methane Control in Eastern United States Coal Mines," mentions

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that American coals may contain from 50 cubic feet to 3,000 cubic feet per ton of coal. It estimates that a bituminous mine in a gassy seam, producing 5,000 tons per day may produce 5,000,000 cubic feet of methane gas per day, or more. Clearly this is a major energy resource.

The statement on page #8-59, "The supply of low-sulfur coal in the East is limited" is a gross untruth. It is a lie so significant as to invalidate the entire Draft's section on alternatives. The Bureau of Mines estimated 77,661,000,000 tons of low sulfur (1% sulfur or less) coal existed in Eastern Kentucky, Western Virginia and West Virginia in 1965. Subtracting all the coal mined from these areas from 1965 - 1973 and assuming only 1/2 of this coal is available for practical extraction, some 35 billion tons of low sulfur coal exists in these three states alone! Additionally, a Bureau of Mines study of easily strippable coal reserves, done in 1971 and entitled "Strippable Reserves of Bituminous Coal & Lignite in the United States", showed that Alabama, Tennessee, Eastern Kentucky, Virginia and West Virginia had 1,861,500,000 tons of easily surface mined low sulfur coal. No responsible survey, up to the past 12 months, has suggested that Eastern low sulfur coal was in short supply, merely high priced. Assumptions made throughout this Draft, based on this novel and false assumption, must be inaccurate as a result.

The section on nuclear power (8-81) grossly underestimates the environmental problems of this form of energy production. Examples of the problems include the recent discovery of plutonium in the Erie Canal in Ohio, as a result of the manufacture of fuel for atomic power. At the same time some reports indicate American reserves of uranium are quite limited, introducing another, major, negative aspect to plans to replace coal plants with nuclear power plants. The Draft is very inadequate in this area, as a result.

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The alternative of "curtailment of Federal Leasing" (8-130) has many favorable aspects not mentioned in the Draft, especially as part of an alternative to promote utilization of Eastern coal, in the East. The 40% of the Western coal cited in the Draft, owned by state, Indian and private organizations amounts to over 346 billion tons. This is more than enough coal to take care of current and anticipated coal needs west of the Mississippi. Western coal is not needed east of the Mississippi, and it is not good national policy to mine great amounts of Federal coal to promote movement of Western coal into Mid-west and Appalachian coal markets. The suggestion that freezing future Federal coal development into existing tenure patterns will put massive pressure on Western private coal lands is inaccurate. Instead, it will encourage greater utilization (pressure) of Appalachian low sulfur coal. Sites near the Appalachian coal fields are well suited to accept additional industrialization and are far better located, near the Eastern population centers, than are proposed Federal coal leasing sites.

The section on deep mining indicates the writer's gross lack of knowledge of underground mining technology. Longwall mining in particular, seems little understood. The statement that, "...current recovery techniques... precludes attempting to mine by underground methods coal that is thicker than 15 feet," is not true. Seams thicker than this are mined in Europe and could be mined in America, using longwall techniques. This point was recently brought out by the June edition of "Fortune" magazine in the article entitled, "It's Back to the Pits for Coal's New Future". Longwall sections in Europe and the United States will show far lower injury rates than those listed in the Draft for the coal industry as a whole. Additionally, it should be noted that ten major deep mines in West Virginia alone had no injuries or deaths during 1973 and that deep mines owned by steel companies in Pennsylvania and in other areas have safety records far superior to those listed in the Draft. This indicates that underground mining can be conducted safely,

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contrary to the impression left in the Draft.

The statement, "Subsidence cannot be properly controlled in shallow deposits", is simply untrue! With longwall mining, subsidence is immediate and especially under shallow cover, is easily predicted. The statements about this subject are referring to older forms of deep mining, strictly. Obviously the writer has never seen longwall mining in action. Longwall mining can remove 100% of a block of coal and subsidence could be completed in a longwall mined area, in areas like the Northern Great Plains, within a few years of the initial mining. Also, as noted in the February 1974 edition of "Coal Mining and Processing" magazine, deep mine gob can be stowed underground during mining, to limit both subsidence and surface problems connected with gob disposal. Longwall mining, of course, leaves no gob above ground, other than small amounts from the tunnels driven to "set up" each longwall section.

Underground mining, contrary to the suggestion on page #8-133, can create a more stable socio-economic impact in an area, due to its longer term, thus avoiding the "boom and bust" cycle often associated with surface mining in areas without other forms of coal operations.

The cost factors of underground mining are misrepresented as they relate to Eastern low sulfur coal. Eastern low sulfur coal may cost more to deep mine than Northern Great Plains strip coal, but when transportation costs are included, Eastern low sulfur coal, even when deep mined, is cheaper under long term contract, than Western coal east of the Mississippi River. Federal Power Commission records, for example, show that it cost 87 1/5¢ per million B.T.U.'s to use strip mined Montana coal at John Amos Plant, Putnam County, West Virginia. West Virginia low sulfur coal (0.8% sulfur) from an underground mine, with a long term contract, cost 43 9/10¢ to 46 1/5¢ per million B.T.U.'s while low sulfur surface mined coal, under contract for John Amos, cost as little as 31 1/2¢ per million B.T.U.'s. Coal purchased on the "spot"

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market from Eastern Kentucky (1.1% sulfur) cost only 69¢ per million B.T.U.'s at Conners Creek Plant in Detroit while "spot" market West Virginia coal (1% sulfur) cost only 42 7/10¢ per million B.T.U.'s at the Dearborn, Indiana power plant. At the same time bituminous coal from Utah cost $27.81 per ton to mine and ship to Ohio River System power plants, far higher than the total cost of any Eastern coal from long term contracts.

The so-called Mansfield Amendment to the Federal surface mine bill is attacked on page #8-134. Actually the indicated impact of this proposal would be most helpful in encouraging a healthy and balanced development of both Eastern and Western coal. It is surely not in the national interest for the Federal Government to go into the coal business, when so much privately owned low sulfur coal exists in both the east and the west. Enactment of the Mansfield Amendment will have the effect of limiting the amounts of Western coal available for immediate development. This will tend to restrict the amounts of Western coal available for export east of the Mississippi and encourage utilization of Western coal where it is needed, west of the Mid-west and Appalachian market areas. To suggest, as this Draft surely implies, that the Mansfield Amendment will prohibit full development of industrial and utility plans for the West, is surely a misrepresentation. It is estimated that Burlington Northern Railroad, itself, owns 11 billion tons of relatively low sulfur strippable reserves in the West. Union Pacific Railroad is estimated to own some 10 billion tons of similar coal. Thus, this privately owned coal alone could take care of Western utility needs for coal, if increased by 10 times, through the end of this century. Together with State, Indian and Eastern coal reserves this clearly demonstrates that no need for Federal coal exists. However, the Secretary of the Interior announced on November 9, 1973, that the Mansfield Amendment would effect only 38% of the land having Federal coal and Interior has estimated that some 40% of the West's coal (over 640 billion tons) is privately owned. The

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The Mansfield Amendment, then, would not prevent mining of any of this private coal plus an additional 626 billion tons of Federally owned coal! This, in turn, will allow the coal industry in the Eastern areas to expand production, in response to increased energy needs in their areas and to take up slack caused by restricted or overpriced oil and gas supplies. Current expectations of massive strip mining of Federal coal in the West have resulted in several long term contracts by Mid-west utilities for Western coal, a massive pro-Western coal publicity campaign by American Electric Power, and a proposed shift of investment capital into Western mining ventures. All of these things tend to depress or at least restrict, the potential for long term expansion of the utility markets, for Eastern coal. Passage of the Mansfield Amendment will surely restrain the flow of investment capital and long term contracts west, and instead stimulate additional coal development in the East, either in the Appalachian low sulfur field or possibly in the high sulfur areas in connection with the sulfuratin process, stack gas cleaning or blending with low sulfur coal.

The "shortfall of low sulphur coal," predicted by 1975, mentioned on page #8-135 needs to have its source identified. If it is the Federal Power Commission, the study cited is totally invalid. That study, entitled "Staff Report on Potential Effects of Air Quality Regulations on the Bulk Electric Power Supply", predicts a "shortfall" for West Virginia's giant John Amos plant. This plant lies on the edge of the Appalachian low sulfur coal field and even American Electric Power admits that plant can meet Clean Air Act standards using West Virginia low sulfur coal. Amos is the nation's largest single site coal burning plant, now slated to use 7 1/2 million tons of bituminous coal per year, it might be added.

Proposed Additions to the
"Final Environmental Impact Statement On Proposed
Federal Coal Leasing Program"

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1. Jones Amendment Impact - The proposed Federal surface mine act, as approved by the U. S. House Interior Committee, contains a provision for a reclamation tax on all coal, deep as well as surface mined. This tax is to be raised by the unprecedented method of taxing coal production from a particular mine on the basis of its heat value! Authored by a congressman from Oklahoma, this tax would amount to 1 3/10¢ per million B.T.U.'s of heat value in the coal mined. All previous reclamation taxes have, it should be mentioned, been based on the tons of coal produced (Ohio) or the acres of land distributed (West Virginia). None have ever taxed deep mined coal.

The effect of this tax, if enacted, will be to concentrate new coal development, on both Federal and private lands, in the sub-bituminous and lignite coals of South Dakota, North Dakota, Colorado, Montana and Wyoming, as well as on the Indian reservations of Arizona and New Mexico, much of whose coal is sub-bituminous also. This is so because this tax on production will cost up to twice as much per ton of high B.T.U. bituminous coal mined as it will for certain low B.T.U. lignite coals in North Dakota. Thus, bituminous coals generally, and especially the highest quality coals from areas such as McDowell County, West Virginia; Harlan County, Kentucky; and Dickenson County, Virginia, will be hardest hit by this tax. So, too, will the mainly deep mined bituminous coals of Utah and Colorado and the surface mined, high B.T.U., bituminous coals of Oklahoma. Thus, coal burned in American Electric Power's Kammer Plant, during 1973, from the Amax mine in Wyoming, would be charged 22¢ per ton under this scheme, and coal from the Slab Fork Coal Company's deep mines in Raleigh County, West Virginia, would be charged over 38¢ per ton. Coal from North Dakota's Beulah mine would be taxed at a rate of 18¢ per ton, while coal from Oklahoma's Stigler mine would pay as much as 36¢ per ton. Together with the fact that most of the bituminous coal mines have been organized by the United Mine Workers of America and must now pay 80¢ per ton of coal produced to the U.M.W. Welfare

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and Retirement Fund, the Jones Amendment will have two likely impacts.

One will be to discourage investment, to some degree, in the bituminous coal fields of the East, particularly in Eastern deep mining. The Jones Amendment will be viewed by potential investors as a non-productive tax that can be minimized by investments in thick seamed coal mines that have a lower B.T.U. level but also a low sulfur content.

The other will be to shift new coal development from the bituminous mines of Oklahoma, Colorado, and Kansas to the Federal and private coal lands of the Northern Great Plains. This sort of tax actually makes the low B.T.U. coals that much more competitive with Mid-western and Appalachian coals and will surely increase the shipment of Northern Great Plains coal into Oklahoma, Kansas, Michigan, Ohio, Kentucky, Indiana and West Virginia. It amounts to a Federal subsidy of about 17¢ per ton for low sulfur lignite and sub-bituminous coal as opposed to low sulfur bituminous coal and will intensify market pressure on Federally owned reserves of lignite and sub-bituminous coals.

2. Impact of Federal Restrictions on Valley-fill Surface Mining. -- Both the Senate passed surface mine bill (#S425) and the House Interior Committee bill (#HR11500) contain sections that, if enacted, will restrict production of Appalachian low sulfur coal and thus increase development pressure on Western Federal and private coal reserves. These restrictions come from wording in each bill which amount to prohibitions on use of so-called "valley-fill". Such techniques involve removing the top of several mountains and depositing the resulting spoil on those mountain tops and the hollows between, thus creating a level plateau area, after total removal of the coal seams involved has been affected. This technique has been developed in the low sulfur coal field of Eastern Kentucky and Southern West Virginia. When properly engineered its environmental effects can be minimal as at the

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newer operations of Cannelton Industry's huge mine in Fayette County, West Virginia. However, some purists object to leveling of mountain tops generally, and the reclamation restrictions required to insure environmental protection during such mining are poorly understood. Thus, #S425 eliminates valley-fill by prohibiting placement of spoil, other than the "first cut", on the down-slope. Such placement is vital to creation of the "fill" part of a valley-fill project. However, certain mountain-top removal projects will be able to live with this wording. The wording of #HR11500, while superficially more liberal, is actually much more restrictive. It requires a fairly substantial commitment to redevelopment of the mined area for a "higher use" such as a residential development before a permit is allowed that does not require returning the land to the "approximate original contour". Almost no coal companies have development arms established that can provide such commitments prior to the mining, especially since use of mountain-top removal or valley-fill techniques is determined by coal production needs and possibilities, not redevelopment plans. #HR11500 would, then, restrict (prohibit) use of both mountain-top removal techniques and valley-fills, no matter what environmental controls a mining operation proposed.

3. A Section on Eastern Coal Development Alternatives -- This section should cover the following points, at the very least, in order to allow a full and fair evaluation of the "need" for Federal coal leasing.

A. Huge amounts of low sulfur coal exist in the Eastern United States, with the center of these reserves in the Southern West Virginia, Eastern Kentucky, Western Virginia region. The U. S. Bureau of Mines has also determined (R.I. #7633 - "Sulfur Reduction Potential of the Coals of the United States") that many of the major medium sulfur seams of Appalachian coal can be washed and crushed to levels of 1% or less. Information from the West Virginia Coal Association documents that West Virginia cleans more coal (for sulfur and/or ash) than any other state, it might be added. The Bureau

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further found that, as of January 1, 1968, Alabama, West Virginia, Virginia, and Eastern Kentucky, alone, had some 3,787,000,000 tons of easy to surface mine low and medium (1.1%--2%) sulfur coal. Estimated coal reserves in coal seams of West Virginia, alone, that have a low or medium (2% or less) sulfur content, totaled over 71 billion tons in 1965 in 20 major seams. While only 50% or so of that coal may be recoverable, newer mining techniques (valley-fill, longwall, etc.) may allow far greater recovery than estimated in 1965. Additional reserves of low sulfur coal have been located in Appalachia since that date. During January, 1972, some 197 million tons were discovered in Wayne and Lincoln Counties, West Virginia by the Columbia Gas System, for example. The West, therefore, is not the only area with undiscovered reserves of low sulfur coal, as implied by supporters of Western coal development It should, in any case, be clear that enough privately owned low sulfur coal in both the East and the West exists to meet anticipated coal demand for utilities export (some 50 million tons a year), steel making and gasification to eliminate the need for Federal coal in the West, and/or east of the Mississippi. However, the vast reserves (and many mines) of high sulfur bituminous coal, stretching from Kansas to Pennsylvania, are greatly threatened by the standards of the Clean Air Act. Massive Federal support of gasification and similar new technology is needed to allow this coal to meet environmental standards. Continued efforts to gasify Federal lignite and sub-bituminous coal does not meet this need and promises a major depression in the high sulfur coal fields, barring unexpected breakthroughs in coal cleaning, coal burning or stack gas cleaning technical problems by next year.

B. It is claimed by massive Federal coal development supporters, when pressed to discuss Eastern low sulfur coal, that it is committed to steel companies or foreign buyers, is in seams too thin to mine economically, or is in a part of the nation which has lost the capacity to expand, to any significant degree, its coal production and is rocked by labor unrest and

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mining accidents. The facts are that the largest owner of land in the Appalachian low sulfur field is the Norfolk and Western Railroad. Steal companies do not control as much as even 25% of this coal. Additionally, at least four steel firms regularly sell coal to utilities in Pennsylvania, Alabama and West Virginia. These include Bethlehem Steel, Algome Steel, U. S. Steel and Alabama Pipe & Foundry Company. Both U. S. Steel and Alabama Pipe have (in 1973 and 1974) agreed to open up new medium and low sulfur mines strictly for use by utilities, in exchange for satisfactory long term contracts. Thus, even reserves controlled by steel companies cannot be considered out of the market for utility, industrial or export use, under the proper circumstances. Connected with this issue is the false claim, stated or implied in several studies of coal (including the MITRE study done for the Environmental Protection Agency), that so-called "metallurgical" coal should not or cannot be used in utility boilers or considered in estimates of low sulfur coal reserves in studies that consider needs other than steel manufacturing. The fact is that terms such as "utility coal" or "steam coal" are meaningless, while the only true definition of "metallurgical coal" is coal that has properties which can be used to produce "coke". Such coal can be medium or high sulfur, as well as low sulfur. The U. S. Geological Survey states such coal can be found all over the nation, from Pennsylvania and Ohio to Alabama and Oklahoma and from Illinois and Indiana to Utah and New Mexico. Thus, opposing the use of Appalachian coal which can be used to make coke, for meeting the Clean Air Act, on grounds of "national security" makes no sense, due to the huge quantities of such coal, in Central Appalachia and outside it as well. It is true that certain high fusion temperature and very low volatile percentage Appalachian low sulfur coals produce burning problems in certain power plants. However, "blending" of low volatile coal with easily obtainable high volatile coal can eliminate any significant problem in that area. Plants that need low ash fusion temperature coal are a greater problem,

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but very few such plants exist. Enough low sulfur, low fusion coal exists in Virginia, Alabama, and West Virginia to fuel those few plants with a need for this type of coal. Also, 1973 and 1974 tests of burning high fusion-low sulfur Appalachian coal by American Electric Power and Allegheny Power, mixing lime with the coal, proved successful in two plants that normally must burn low ash fusion temperature coal. Meanwhile, both Alabama Power Company and American Electric Power are now burning, in some plants, coal which is openly called "metallurgical" and one West Virginia producer has opened a cleaning plant which can produce "met" coal from coal which otherwise would be called "steam coal" by upgrading the cleaning and treatment process. It should be added that tests by the T.V.A. and American Electric Power, have demonstrated that many Eastern power plants have great problems efficiently burning Western sub-bituminous and lignite coals, because of their low B.T.U. content, high (25% to 50% water) moisture content and lack of crystal structure. Thus, the "need" for much of the Federal coal at issue in the leasing proposals, east of the Mississippi, actually is greatly reduced because of its qualities, as far as most existing power plants are concerned.

Contrary to private comments by certain Federal officials and public remarks by certain supporters of Federal coal leasing, the Appalachian low and medium sulfur coal industry has considerable ability to expand production relatively quickly, under the right contract conditions. Both expansion of existing mines and opening of new mines are possibilities that have been proven to produce coal quickly. For example, Union Carbide Corporation announced, in 1972, expansion plans at its mining operations in Kanawha County, West Virginia, to be completed that year. Both Carbide deep mines involved have gone without a single reported accident or death since that time. During 1973, Pitteton Coal Company continued to cut back production at its Moss #3 Mine, in Dickenson County, Virginia. By the end of 1973, Moss #3 had laid off enough miners and closed enough portals to reduce its production by some 2

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million tons of low sulfur coal. Obviously, the right price and term of contract could result in a major increase in coal production from this mine's recent level of 4 million tons or so a year. In Alabama, Great Northern Nekoosa Corporation announced, in March, plans to triple the coal production of its Brilliant #1 and #2 Mines.

Utilities have also been able to obtain large blocks of low sulfur Eastern coal by offering long term contracts and other inducements. However, utilities that have attempted to purchase, outright, Eastern coal leases have had, generally, less success than they have had on Western Federal and private coal lands. Utilities which have recently signed contracts for Eastern low and medium sulfur coal from new mines include: Carolina Power and Light Co. (Eastern Kentucky); Duke Power Co. (West Virginia); Ontario Hydro (Pennsylvania); Detroit Edison (Eastern Kentucky); American Electric (West Virginia) and Alabama Power Co. (Alabama). The critical factor to increasing low sulfur coal production in the East appears to be price and term of contract. The financing of the new mine and granting a "cost plus profit" long term contract by Duke Power and Ontario Hydro-electric seem to represent a pattern that will allow virtually any interested utility to unlock large amounts of Appalachian low sulfur coal from their owners, be they the Chessie System, Island Creek Coal Co., Westmoreland Coal, Jim Walter Corp., or U. S. Steel Corp.

Labor unrest is a problem in the Appalachian coal fields. However, the new contract the United Mine Workers will negotiate this year with the Bituminous Coal Operators Association is expected to reduce the kinds of friction which has contributed to a considerable amount of this unrest. Additionally, labor problems are not confined to the East. The recent confrontations between the U. M. W. and local coal companies at the Hanna, Wyoming Mine and at the Navajo Mine in New Mexico are likely just the start of such labor problems in the Western fields. Picketing and other activities to resist shipment of

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non U. M. W. coal into Eastern power plants from Federal coal lands in the West seems a very likely possibility. The U. M. W., for example, closed down the Alabama coal fields for a day, this past May, in protest against plans to import South African coal to Southern utilities through the port of Mobile.

Safety conditions, especially in underground mines, are a factor that contributes to labor unrest as well as being a problem in itself. However, progress in many mines is illustrated by certain U.S. Steel Company mines in Pennsylvania and certain Westmoreland Coal Company mines in West Virginia, where large work forces completed 1973 with no injuries or deaths to the work force. National statistics show that most miner's who are injured or killed had less than 4 years' work experience at the time. Recognition of this fact, revealed during a 1973 study of the coal industry by the West Virginia legislature, led that state to pass the first state sponsored miners training and testing program, for new miners, in the nation. A somewhat similar program is being considered by the U. S. Bureau of Mines. Such required training and final testing seems very likely to increase productivity and decrease accidents among the younger miners in major deep mining states such as West Virginia, Pennsylvania, Virginia, Illinois and Kentucky, a point totally overlooked in the Draft. Mine deaths also have been reduced in many areas of Appalachia by ventilation requirements of the Federal Health and Safety Act and the increasing rise of underground mining technology such as longwall units, shortwall units, roof bolting systems and remote controlled continuous miners and roof bolting machines. Continuous miners and longwall systems also eliminate the need for explosives to "shoot" the coal loose, which eliminates one constant source of deaths in underground mining.

The suggestion that most Eastern low sulfur coal is in seams (3 feet or less) too thin to mine is false on three counts. One, it is not generally true. Two, thin seams have been mined successfully for years and can continue

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to be. Three, fairly large amounts of low sulfur coal can be surface mined in Appalachia, where seams as thin as 18 inches are now mined, at a profit. Representative seam sizes are the 5 foot seam of low sulfur coal at Island Creek Coal Company's Pevler #1 Mine in Eastern Kentucky, the 4 foot seam at Westmoreland Coal Company's Pine Branch Mine in Virginia and Consolidation Coal Company's 42 inch seam at its Sycamore Mine in West Virginia. Also, American Electric Power's 55 inch seam at its Morris Creek (West Virginia) Mine. At the same time a good number of low sulfur mines have far thicker seams, such as the 8 foot seam at U.S. Pipe & Foundry's Bessie Mine (Alabama) and A. T. Massey's 96 inch thick seam at its Martin County Mine (Eastern Kentucky). Several new low sulfur mines being opened in West Virginia during 1974 have 7 foot thick seams, it should be noted.

Additionally seams as low as 24 inches have been successfully deep mined for many years in the Eastern low sulfur coal field. Currently, continuous miner machines that can handle seams as thin as 27 inches are on sale and the development of remote control equipment is making thin seam deep mining increasingly productive and more comfortable.

C. At this time, when short term needs for low sulfur American fuels are a major reason given in support of massive stripping of Federal coal leases in the West, the fact is that Eastern deep mines can be opened faster than Western surface mines. This fact contradicts most "common understanding" and statements by certain coal industry officials. Nevertheless, it appears to have a solid base of evidence.

This is so because the smaller, mass produced, types of surface mining equipment (bulldozers, and front end loaders) now take 12 - 24 months to obtain new, due to the limited manufacturing capacity of their makers, plus competition from highway builders and other industries. However, most mines proposed for Federal coal leases would be dependent on giant power shovels

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and draglines, such as those now operating at Black Mesa (Arizona) and Decker (Wyoming). These machines must be made to order and are generally manufactured by two firms, Marion Power Shovel Company (Marion, Ohio) and Bucyrus-Erie (Milwaukee, Wisconsin). After these machines are manufactured and shipped, it can take up to 11 months just to assemble them at the mine site. This was the time for erection proposed for a 70 cubic yard bucket dragline on order in 1973 for Wyoming's Jim Bridger Mine, for example. The two leaders in this field are now suggesting that, even with major expansion of their facilities during the next 1 1/2 to 2 years, they are "booked solid" through 1976 and beyond. "Forbes Magazine" of March 15, 1974, and a Putnam McDowell speech of January 29, 1974, both strongly suggest this fact, as do announcements from different Western surface mining interests.

Meanwhile, Appalachian low sulfur deep mines have been opening with times ranging from 1 year to 3 years before the first coal is produced. Eastern Associated Coal Corporation (which has large low sulfur reserves between Beckley and Montgomery, West Virginia), for example, produced coal at its new Keystone #5 Mine within 18 months of the time construction started. Alabama Power Company has indicated a new deep mine it signed a 21 year contract to open, will be producing coal a little more than 2 years from the start of construction. Pickands Mather & Company's new Eastern Kentucky mine has announced production will take place within 2 years. Cannelton Industries' new Fairdale, West Virginia, mine started production in slightly less than two years, this summer. The Chessie System plans to have coal moving from another new West Virginia deep mine, to France, in less than 3 years while 2 small West Virginia deep mines of American Electric Power are slated to produce within 1 1/2 years of their start. A new surface mine in Eastern Kentucky is scheduled to begin production in just over 12 months, according to Mapco, Inc., and Island Creek Coal Company has announced a new 300,000 ton a year deep mine for Buchanan County, Virginia, which will employ some 575 men. Meanwhile, Kanawha

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Coal Company broke ground for its new deep mine near Ashford, West Virginia, in December, 1970 and produced its first coal by July, 1972 and Valley Camp Coal Company announced a new mine for American Electric Power, near Cedar Grove, West Virginia, would be completed by July, 1976, 29 months from the start of construction.

These relatively short "lead times" for new mines, compared to times needed to open Western surface mines on Federal and private lands are encouraged because most Eastern low sulfur coal reserves are well mapped, road or rail facilities already exist and since manufacture and purchase of specialized mining equipment can go on while the mine shaft is being constructed and equipped. Also, while some longwall equipment must still be purchased from Europe, certain types of deep mine equipment are manufactured within Appalachia and items like continuous miners are mass produced to a greater extent than are dragline and power shovel parts. While total costs for opening new Eastern deep mines and Federal coal lease surface mines seem to be similar ($10 million - $30 million) the Eastern mine will, right now, be producing coal faster than the Western surface mine.

D. The "automatic fuel adjustment clause" which most states currently still have are designed, among other things, to subsidize inefficiency, since they force electricity users to pay for the cost of mining and transporting coal to a power plant, plus profit for both operations, without a public hearing. The long hauls required for the low B.T.U. coals of the Federal lands of the Northern Great Plains will generally not be economic compared to Eastern coals, unless the automatic fuel adjustment clauses allow for it to be paid for without question by the Eastern consumer, under the guise of conforming to Clean Air Act standards.

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It makes no sense for the Federal Government to expand its involvement in the coal mining industry when the effect of a goodly part of the coal proposed to be developed will be to greatly increase the use of scarce coal hopper cars and diesel fuel when the same coal production from Eastern mines would result in more jobs and income for men and counties that badly need both to service families who already live in them. To encourage a balanced development of Eastern and Western coal very considerable Restrictions on Federal coal and Federal coal leases for the next decade, are justified. Such encouragement is surely in the national interest, and thus, in the Federal interest.

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ENVIRONMENTAL IMPACT REVIEW
PENNSYLVANIA STATE CLEARINGHOUSE
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Title: DEIS - Proposed Federal Coal Leasing Program Volume 1

Location: Western United States

Applicant: U. S. Department of Interior

PSCH project number: 74-07-3-001

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18th and C Streets, N.W.
Washington, D. C. 20240

Dear Gentlemen:

The Governor's Budget Office, as the State Clearinghouse for the Commonwealth of Pennsylvania, has received and transmitted to various State agencies, including the Department of Environmental Resources, copies of the environmental statement mentioned above.

Attached to this letter please find the comments of the Department of Environmental Resources and the following State agencies:

Please consider these the official response of the Commonwealth in this matter.

Sincerely,

Richard A. Heiss

Richard A. Heiss, Coordinator
Pennsylvania State Clearinghouse

COMMONWEALTH OF PENNSYLVANIA

AUG 29 1974

DEPARTMENT OF ENVIRONMENTAL RESOURCES
P O BOX 1467
HARRISBURG PENNSYLVANIA 17120

The Secretary

August 22, 1974

SUBJECT: Department of Environmental Resources Review and Evaluation of PSCH No.: 74-07-3-001

TITLE: DEIS - proposed Federal Coal Leasing Program Volume 1

LOCATION: Western United States

TO: R. A. Heiss, Coordinator
Pennsylvania State Clearinghouse

Maurice K. Goddard

FROM: MAURICE K. GODDARD
Secretary of Environmental Resources

On the basis of the submitted information found in the Draft Environmental Impact Statement, no significant or adverse impact is anticipated by the implementation of the project. However the Department of Environmental Resources offers these comments.

This project has been evaluated on the basis of the actions proposed in the applicant's submission. Any approval, granted or implied, does not extend to any changes made by the applicant subsequent to and not in keeping with our recommendations. Any such changes will require a new submission through the Pennsylvania State Clearinghouse.

R. A. Heiss 2 August 23, 1974

1. The adverse environmental effects of mining throughout the United States has been discussed in considerable depth. However, the discussion relating to surface mining in the Great Plains Area was inadequate. In this part of the country aquifers are usually found in coal seams. This, together with the shortage of water in the west, requires special consideration due to the probable adverse effect it could have on ranching and other forms of agriculture. These factors have not been adequately explored and discussed in this draft EIS. Without adequate investigation of the aquifers located in the coal seams and the effect of their removal, the high plains now used as grazing and grain lands could become a desert and useless for any agricultural purposes despite the reclamation efforts to eliminate the scars of surface mining.

2. On pages I-110 and I-112 the report proposes auger mining to recover coal between abandoned underground mines and adjacent strip mines, and then sealing the auger holes with an impervious material.

Auger holes can only be properly sealed by certain grouting. Augering to the rise with a slope of 1% or greater should be prohibited. For any other situation, a barrier of at least 100 feet should be left between the furthest auger penetration and the abandoned deep mine. Otherwise, there would be often a pollutional discharge from the auger holes.

3. Since there has been limited mining in this area, any that is permitted should require stringent environmental quality controls with pre-operation, operation, and post-operation monitoring of the effects on surface and ground waters. This will aid in technology development as well as environmental protection.

4. We have reviewed in detail the subject environmental impact statement and recommend a number of modifications for technical clarity and correctness. In Volume 1 of the subject statement the proposed corrections are annotated on the attached sheets which have been xeroxed from the draft statement.

5. The Department of Environmental Resources retains an interest in this project and desires to be informed of any adverse environmental effects encountered or anticipated in the further development of this project.

Attachments

STATE OF WASHINGTON
Department of
Natural Resources

COMMISSIONER
BERT COLE

DON LEE FRASER
SUPERVISOR

OLYMPIA, WASHINGTON
98504

May 22, 1974

Curt Berklund, Director
Bureau of Land Management
Washington, DC 20240

Dear Mr. Berklund:

The draft environmental impact statement for the Federal coal leasing program has been reviewed by my staff. This is a very thorough assessment of the environmental effects of coal removal and will very likely serve as a baseline for future studies of this type.

There is one slight error on page II where it states that coal is still being mined in the Roslyn area of Washington. These mines were closed in 1963 and have not produced any coal since that time.

We appreciate having an opportunity to review this statement.

Sincerely,

Bert Cole

BERT L. COLE
Commissioner of Public Lands

BLC:vbj

Colorado
Division of Planning

John D. Vanderhoof / Governor

1575 Sherman Street / Denver, Colorado / 80203

Philip H. Schmuck / Director

Department of Local Affairs

Phone / (303) 892-2178

August 13, 1974

Mr. Curt Berklund, Director
United States Department of the Interior
Bureau of Land Management
Washington, D. C. 20240

SUBJECT: Draft Environmental Impact Statement, Proposed Federal Coal Leasing Program

Dear Mr. Berklund:

The Colorado State Clearinghouse has reviewed the Draft Environmental Impact Statement (DES) for the Proposed Federal Coal Leasing Program. The DES provides voluminous information about coal mining and the federal leasing program but overlooks some very important matters that should properly be addressed in an environmental impact statement.

1. The proposed Federal coal leasing program is really a part of a larger program of "domestic self-sufficiency in resources" (I-5*). If the purpose of EMARS is "to effectively implement national energy policy" (I-1a), this national energy policy must be clearly delineated in the DES. In fact, this policy should more properly be the subject of a separate EIS before programs to implement this policy are studied.

   a. The Clearinghouse recommends that an environmental impact statement be prepared concerning this "national energy policy" so that the relationship of the proposed Federal Coal Leasing Program to an overall national energy policy can be determined.

   b. The relationship of the coal leasing program to other Federal energy development programs must be determined. Council on Environmental Quality (CEQ) guidelines stipulate that "the statutory clause 'major Federal actions significantly affecting

*All page references, unless otherwise noted, are to Proposed Federal Coal Leasing Program, Volume 1 and 2.

Bureau of Land Management
Re: Proposed Federal Coal Leasing Program
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Page 2

the quality of the human environment' is to be construed by agencies with a view to the overall, cumulative impact of the action proposed, related Federal actions and projects in the area, and further actions contemplated" (38 FR 20551). Again, it is evident that an overall "national energy policy" must be enunciated so that the environmental costs and benefits of the coal leasing program can be related to the overall cumulative impacts, both positive and negative, of our "national energy policy" in accordance with CEQ guidelines and the provisions of Title I of the National Environmental Policy Act of 1969.

   c. The "comprehensive planning process" and "management framework plan" mentioned on page IV-5 for an "individual resource" should be prepared for all energy resources so that the exploitation of one resource can be coordinated with that of other resources.

2. The "measures to mitigate environmental impacts" discussed in Section IV should be much more specific and definitive, particularly if pending Federal strip mining control legislation becomes law.

   a. There is no indication that any of the "detailed specific mitigating measures (IV-16, et.seq.) will be enforced.

   b. What is "irreparable damage" (IV-19) and how will this be determined prior to drilling?

   c. If, according to the CEQ, " 'area mining in the far West may well be unacceptable unless vegetation can be re-established' " (IV-31), and, if "in desert with 10 inches or less of precipitation or areas with sodic soils, revegetations may be impossible" (IV-47), then these areas should be mapped and mining prohibited.

   d. Mining in areas of extremely fragile ecosystem, as the Northern Alaska Coal Field (III-52), should be categorically prohibited.

   e. Mining should not be allowed in areas where successful revegetation is in doubt (IV-46).

   f. Wilderness areas should not merely be avoided (IV-56) but declared off-limits for all mining activities.

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Page 3

3. The discussion of the secondary impacts of the proposed action must be expanded to include impacts created by the use of the coal to be mined. CEQ guidelines stipulate that if population and growth impacts are expected to be significant, an assessment should be made of "... any possible change in population patterns or growth upon the resource base, including land use, water and public services, of the area in question" (38 FR 20553).

4. In the discussion of alternatives to the proposed action, the environmental costs and benefits of the alternative, "Conservation of Energy Use," is treated rather perfunctorily (VII-127). The impact of this alternative will depend on the quantity of energy conserved and not just on the "energy mix" (VIII-27) that results. Some attempt should also be made to determine a feasible optimum "energy mix" that would minimize environmental and social-economic impacts. Also, some specific legislative proposals and administrative procedures to implement an energy conservation alternative should be analyzed, even though the proposals and procedures may not be within the existing authority of the BLM (see CEQ guidelines, 38 FR 20554).

I am aware that environmental impact statements may be prepared for individual leases (I-130) if they are deemed needed, but these individual impact statements will only reflect the policies, priorities and judgments made for the overall lease program. Consequently, it is important that the proposed Federal coal leasing program be related to an overall national energy plan and that all alternatives be subjected to "rigorous exploration and objective evaluation" (CEQ guidelines, 38 FR 20554) in the DES.

Thank you for providing the opportunity to review and comment upon this DES. If the Clearinghouse can be of assistance in preparing a final draft, please let us know.

Sincerely,

Phil Schmuck

Philip H. Schmuck
Director

PHS/JD/vt

cc: See attached list

Bureau of Land Management
Re: Proposed Federal Coal Leasing Program
August 13, 1974
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cc: John Bermingham, Assistant to the Governor on Environmental Affairs and State Planning
J. D. Arehart, Executive Director, Department of Local Affairs
Gil McNeish, Director, Land Use Commission
John Rold, Director, Colorado Geological Survey
Norman Blake, Deputy Commissioner, Division of Mines
Robert McPhee, Commissioner, Board of Land Commissioners
Pat Halligan, Director, Colorado West Council of Governments
Russell Lombard, Regional Coordinator, District 10 Regional Planning Comm.
William Gibbons, Director, San Juan Basin Regional Planning Commission
Robert Klausing, Chairman, Interagency Planning Committee, Mountain Plains Federal Regional Council
Mrs. Ben Eastman, Delta County Planning Commission

STATE OF NEW MEXICO
Environmental Improvement Agency
HEALTH SAFETY WELFARE COMFORT
P. O. Box 2348, Santa Fe, New Mexico 87501

June 14, 1974

SPECIAL PROJECTS SECTION

Mr. Stu Carson
Bureau of Land Management
U.S. Department of the Interior
Interior Building
Washington, D.C. 20240

Dear Mr. Carson:

Pursuant to our telephone conversation the following comments are submitted with reference to DES 74-53, Draft Environmental Impact Statement for the Proposed Federal Coal Leasing Program.

We support the concept of a planning system to determine which coal leases can be and should be utilized to meet the nationa energy needs with the least possible environmental, social or aesthetic damage.

Our primary concern with this statement is its limited treatment of the water resource which must be expended if the coal is developed as described in the plan. We are certain that the Bureau of Land Management is aware of thia chain of circumstances which are set in motion when water resources are tied up. For this reason, we would like to see a substantially more detailed study on water use in conjunction with this proposed program. While we do not necessarily subscribe to any "environmental domino theory," it would appear that more coal exists in the Rocky Mountain area than does the water with which to develop it.

It is for these reasons that we can support a detailed, coordinated, long range planning system which includes the proposed coal leasing policy.

The following considerations are submitted for inclusion in future drafts or revisions:

p. I-31 Essentially, one sentence stating that quality of life is proportional to quality of the environment was all that the authors knew or considered was

Mr. Stu Carson
June 14, 1974
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required. It would seem that this paragraph could be used to summarize the concern for land use, water and air, etc. or otherwise could be deleted entirely.

p. II-66 Headings such as "Climate-Air" should be renamed "Climatology" since there is no quantification of "air" in this heading. Statements could be made about the general condition of extended visibility, low values of contaminants such as SO_2, NO_x, CO, etc., yet nowhere is background or baseline data shown.

Sect. III It is not adequate to only address and focua on the short range environmental impacta auch as off-road travel during exploration, etc.; the potential environmental impacts are not clearly addressed. How many tona of pollution may be dumped into the air as a result of thia work making coal available for utilization?

P. III-53 The report has used a phrase that implies environmental impact from an exotic threat which probably could be challenged--namely, "the vast amounts of radioactive wastes that are concentrated in the fly-ash." There are no data in the statement to support this. Ignored are the more common wall-known pollutants having a demonstrated environmental impact on the air quality and its impact on plant life, viaibility, use of property, and general well-being of the public within these vast regions.

Sect. IV Measures to Mitigate Impacts - There ia no indication of the degree of difficulty and therefore the probable lack of successa that the proposed methoda may realize. It is acknowledged that spraying the mine with water will keep dust down. Haa the quantity of water required for this activity been passed off as inconsequential?

There does not appear to be any mention that some states (New Mexico for one) have regulations in effect in addition to those that the Federal agencies have. These procedures should have some mitigating effect.

Water Requirements for Coal Gasification

The Bureau of Land Management has projected that there will be 36 coal-gasification planta operating in 1985. Each plant will produce at least 250 million cubic feet of pipeline quality gas per day and, depending upon the type of coal, each will be consuming 6 to 10 million tona annually. Such consumption will utilize about 300 million tons of coal each year, an increase of about

Mr. Stu Carson
June 14, 1974
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50 percent over the total produced in the United States in 1972. Additional coal will be required for liquefaction. It has been projected that requirements in the year 2000 for liquefaction and gasification combined will be as high as 1,274 million tons.

Figures available from the El Paso Natural Gas environmental impact statement show that each 250 million cubic feet plant requires 9,400 acre feet of water a year. Thirty-six plants would require 338,400 acre feet a year (figuring .001128 acre feet per ton of coal).

An increase of coal consumption from 300 million tons in 1985 to 1,274 million tons in the year 2000 represents an annual growth rate of 10 per cent.

The following table shows growth in coal and water. Assuming water cooling:

Year	Tons (millions)	Acre Feet (Thousands)
1985	300.00	338.4
1986	330.00	372.2
1987	363.00	409.5
1988	399.30	450.4
1989	439.23	495.5
1990	483.15	545.0
1991	531.47	599.5
1992	584.62	659.5
1993	643.08	725.4
1994	707.39	797.7
1995	778.13	877.7
1996	855.94	965.5
1997	941.53	1062.0
1998	1035.68	1168.3
1999	1139.25	1285.1
	1253.18	1413.6
Total:	10,784.95	12,165.5

It is hard to believe that the growth rate will be an even 10 per cent per year. Various company plans show project life of 25 to 30 years. Growth will be in lumps, and natural resource consumption may be greater or lesser for any given year. It should also be remembered that present day coal-gasification plans show 100% consumption of water.

Non Processing Water Use and Needs

The increase or decrease of a significant number of industrial jobs in a community haa a number of side effects. Among these ia the employment multiplier effect. Reaearch has shown that this

Mr. Stu Carson
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number can range from 1.2[1] (20 support jobs for every 100 industrial jobs) to as high as 3.75[2] for mineral production. The two figures given may be considered extremes, so I will use 1.67, the same figure used by Kennecott before New Mexico's Environmental Improvement Board.

EPNG says it will employ about 870 employees at one gasification plant and the supporting mine. A minimum of 870 x 1.67 or 1,453 persons will be employed because of the gasification plant. If these employees have families averaging 4.5 members there will be approximately 6,538 persons introduced to the area using 200 gallons of water a day or 1,461 acre feet of water a year for non-processing uses, or about 16% of the gasification plant's water needs.

The construction multiplier would range between 1.66[3] and 1.2. Here again we will use an average, 1.4. Thus, 3000 construction workers will create total new employment of about 1200 ancilliary jobs for 4200 total new jobs in the area.

Water Usage in Oil Shale Processing

Volume 1 of the environmental impact statement on Prototype Oil Shale leasing, states that a one million barrel a day oil shale processing unit will require 134,000 to 201,000 acre feet of water a year, using 168,000 acre ft/yr. as an average.

Section VIII-49 states, "In the period 1981 to 1985, capacity is assumed to grow to one million barrels of oil per day".

Now, 168,000 acre ft. contains 1,306,800,000 barrels of water. Production of 1 million bbl/day of oil means about 365 million barrels of oil per year.

Calculation of these figures given in the impact statement show that approximately 3.58 bbls of water are needed for 1 bbl of oil from shale.

Between 1975 and 1980 oil shale production is projected to reach

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[1] Larry Adcock, New Mexico Bureau of Business Research

[2] Based on Employment Security Commission data, 1960-1972; Employment in a Small Economy, Land Economic, Steven J. Weiss & Edwin C. Gooding

[3] Simple Input-Output Models for Economic Analysis, Land Economics p337

Mr. Stu Carson
June 14, 1974
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200,000 bbl/day. This means that about 30,000,000 gallons of water will be used each day, or 33,600 acre ft. a year.

Area to be Strip Mined

If all coal-gasification and liquefaction were to be done by strip mining, the following guidelines would apply according to the statement.

Page I-115 gives Table 12 - Relaionship of Coal Thickness to Production. By using these figures, it is calculated that:

Coal Quantity	Seam Thickness	Stripped Area
1,000,000 tons	15 feet	38.0 acres
1,000,000 tons	20 feet	28.0 acres
1,000,000 tons	30 feet	18.4 acres

The proposed EPNG plant will use 8.8 million tons per year. BLM expects 36 plants like EPNG's. These plants would use 316.8 million tons per year.

316.8 million tons would require the following stripping:

		Area Stripped in Square Miles			
Year	Expected Mining	All @ 15'	All @ 20'	All @ 30'	All @ 50'
1985	300.00 mm tons	17.81	13.13	8.63	5.34
1986	330.00 mm tons	19.59	14.44	9.49	5.88
1987	363.00 mm tons	21.55	15.88	10.44	6.47
1988	399.3 mm tons	23.71	17.47	11.48	7.11
1989	439.23 mm tons	26.08	19.22	12.63	7.82
1990	483.15 mm tons	28.69	21.14	13.89	8.61
1991	531.47 mm tons	31,56	23.25	15.28	9.47
1992	584.62 mm tons	34.71	25.58	16.81	10.41
1993	643.08 mm tons	38.18	28.13	18.49	11.45
1994	707.39 mm tons	42.00	30.95	20.34	12.60
1995	778.13 mm tons	46.20	34.04	22.37	13.86
1996	855.94 mm tons	50.82	37.45	24.61	15.25
1997	941.53 mm tons	55.90	41.19	27.07	16.77
1998	1035.68 mm tons	61.49	45.31	29.78	18.45
1999	1139.25 mm tons	67.64	49.84	32.75	20.29
2000	1253.18 mm tons	74.41	54.83	36.03	22.32
	Total:	640.36	471.84	310.07	192.11

The Navajo mine operation in the Four Corners area has operated since 1962. In the almost 12 year span they have mined 45,658,103

Mr. Stu Carson
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tons of coal and have disturbed 2,800 acres (4.38 square miles). Seam thickness for this operation has been 10 feet. During this period, Arizona Public Service generated 76,189,093 magawatt hours of electricity.

We feel the amount of land to be disturbed is significant and subject for considerable discussion in the final statement.

Conservation and other Alternatives

The Department of Interior should consider an aggressive Federal energy conservation program as an alternative to the proposed plan. The Environmental Protection Agency's "Half and Half Plan" should be considered.

Under the EPA's plan, the target for gross energy consumption in the year 2000 would be 121 quadrillion BTUs, an increase of 49 quadrillion over the 1972 consumption. This figure represents an annual growth rate of 1.8 per cent.

For example , Shell Oil Company[4] states that a possible 20 per cent decrease in energy consumption by the iron and steel, petroleum refining and chemical industries could be reached by 1985. A 5 per cent reduction in energy is considered practicable in textile, mining, food and paper and allied products industries and the stone, clay and glass products industry.

In the area of transportation large quantities of fuel could be saved if smaller, lighter more efficient cars were used, pooling interest was developed, public transportation was increased, passenger air service streamlined and if more railroads were used for the long distance hauls.

New ideas and usages of energy in residential and commercial buildings could develop into more fuel and energy savings. Shell reports that potential short-term energy savings of 938,000 bbls/day crude equivalant could be achieved by focusing attention on homes, commercial buildings and transportation. (Transportation savings are from car pools and airplane load factors only.)

Shell also states that long-term energy savings of 8,470,000 bbls/day could be achieved by 1990.

Conservation issues should now be given consideration and measured against projected demand established independently of conservation.

[4] The National Energy Problem: Potential Energy Savings, Shell Oil Company, Houston, Texas, 1973)

Stu Carson
June 14, 1974
Page 7

A detailed systematic conservation study should be presented.

In conclusion it is urged that an overall comprehensive study be undertaken to evaluate the total impact of all energy development programs currently under consideration by Federal Agencies. The combination of impending development efforts in oil, coal, gas, nuclear and alternate sources of energy may have a cumulative or even synergistic impact upon other resources (such as water) and the environment. Impacts of this combined activity would be greater in extent and magnitude than is currently envisioned or revealed by environmental assessments relating to a single resource.

Yours truly,

Dick Burgard
Environmental Program Manager

DB/sp

STATE OF ALASKA
OFFICE OF THE GOVERNOR
STATE PLANNING AND RESEARCH

WILLIAM A. EGAN, GOVERNOR
Phone 465-3512
POUCH AD - JUNEAU 99801

July 2, 1974

Mr. Curt Berklund, Director
Bureau of Land Management
555 Cordova Street
Anchorage, Alaska 99501

Subject: Proposed Federal Coal Leasing Program
State I.D. No. 74051501

Dear Mr. Berklund:

The Alaska State Clearinghouse has completed review on the subject project.

No adverse comments were received concerning this project.

The Clearinghouse finds this project to be consistent with State long-range planning goals and objectives. Therefore, this letter will satisfy the review requirements of the Office of Management and Budget Circular A-95.

Sincerely,

Raymond W. Estess
State-Federal Coordinator

NORTH DAKOTA STATE PLANNING DIVISION

STATE CAPITOL — FOURTH FLOOR — BISMARCK, NORTH DAKOTA 58501
701-224-2818

June 14, 1974

Mr. Curt Berklund, Director
Bureau of Land Management
18th and C Streets, NW
Washington, D. C. 20240

RE: Draft EIS: Proposed Federal Coal Leasing Program, Volume I and II;
DES 7453

Dear Mr. Berklund:

North Dakota's comments relating to the above referenced draft environmental impact statement will not be forwarded to you by June 24.

Copies of the impact statement were received from BLM for distribution, review and comment on June 5, 1974. The copies were distributed with requests for comments.

Because the issue of Federal coal leasing is vital to North Dakota's interests at this time, and because of the great impact Federal coal leasing practices will have on North Dakota, the State Intergovernmental Clearinghouse intends to utilize 45 days for review of the impact of this important administrative activity. Comments will be forwarded to you on or before July 19. We reserve the right to forward comments received after that date to you for your consideration in the preparation of the final impact statement.

If you have any questions relating to the review of this statement, please contact this office.

Sincerely yours,

Miss Bonnie E. Austin
Associate Planner

BEA:cs

cc: Mr. Edwin Zaidlicz, BLM, Billings
Mr. Russell Peterson, Council on Environmental Quality
Mr. Sheldon Meyers, EPA
Mr. Bruce Blanchard, Department of Interior

NORTH DAKOTA STATE PLANNING DIVISION

STATE CAPITOL — FOURTH FLOOR — BISMARCK, NORTH DAKOTA 58501
701-224-2818

June 28, 1974

Director
Bureau of Land Management
18 C Street, NW
Washington, D.C. 20240

Dear Sir:

Our comments on the proposed Federal Coal Leasing Program Draft EIS are as follows:

1. We think North Dakotans generally agree with "... a land use policy which characterizes coal mining as an 'interim' use of the land, rather than an 'end product' land use". (p. I-10).

2. Energy conversion losses appear to be a major problem. In Figure 1, p. I-26, we note that the estimated conversion loss in 2000 will equal the net energy consumed in 1964. The problem is reflected in statements from p.I-28: "The largest increase in energy needs will be caused by energy conversion losses". The net energy used in 1971 was 82.7 percent of the gross energy produced. This figure was expected to drop to 73 percent of the gross energy production in year 2000. This drop in efficiency is caused by conversion losses in electrical and synthetic gas production".

   This problem can best be met by development of more efficient conversion techniques (such as MHD?). The leasing program might call for a lower leasing rate for coal which is used most efficiently, especially where - as in strip mining - the detrimental impacts are directly related to the volume of coal used.

   Also, these conversion losses suggest that conversion of coal should whenever possible be deferred until more efficient techniques become available, or eliminated in favor of direct use of the coal as a raw material rather than an energy source.

Director, BLM
Page Two
June 28, 1974

3. The figure given (Table I, p. I-29) for gross energy input in 2000 is 191.9 quadrillion BTU's. On March 29, 1974, Russell W. Peterson discussed the "Half and Half" energy plan developed by the Council on Environmental Quality. This plan targets year 2000 energy needs at 121 quadrillion BTU's.

   The final EIS should include a consideration of these lower figures, especially as they relate to the previous comments on efficiency of coal conversion.

4. In discussing (p. I-71) the important role of coal in power generation, it is stated: "This is a result, primarily of high efficiency in the use of coal for power generation and of the relatively low cost of coal"

   How does this claim of "high efficiency" relate to the statements (p. I-28) on energy conversion losses? What is the efficiency level of coal conversion?

5. A map of North Dakota is incorrectly labeled <u>South</u> Dakota. (p. I-186).

6. There appears to be some confusion in the use of the term "ethnic". The statement is made (p. II-183) that, "The Northern Plains Indians are the largest single ethnic group in the Northern Great Plains Coal Province". On p. II-223, the "mountain folk" are described as "a distinct ethnic entity". "American ethnics" are referred to on p. V-8.

   If "ethnic" is used to mean a national or cultural grouping, the statement on p. II-183 may be incorrect in light of the large population classified by the Census Bureau as being of "Foreign Stock".

7. As an example of a beneficial impact on wildlife from drilling, it is stated (p. III-11): "In arrid areas, artesian wells with good-quality water can be of benefit to wildlife if allowed to continue flowing". In discussing semi-arrid areas, it is later stated (p. III-60): "(A)ny effects on hydrology are especially harmful. Contamination or drainage of usable aquifers will severely affect this area because there is seldom an alternate source of water available to users".

Director, BLM
Page Three
June 28, 1974

   It should be noted on page III-11, that any aquifer drainage resulting from flowing wells may have a severe effect on users dependent upon that aquifer. (See item 5, p. IV-19)

8. We strongly support the call (p. IV-17) for an inventory of historic resources and for preparation of a comprehensive area history to aid the development of that inventory.

9. The statement (p. V-1) that, "The major environmental issue is essentially whether or not an orderly system of lease allocation and potential subsequent development is environmentally superior to unregulated leasing", reveals an assumption that leasing of Federal coal should and will occur at the present time. Phrased in this manner, the issue is easily resolved.

   The statement ignores the more basic issue-whether Federal coal should be leased at this time, in light of the availability of substantial private coal reserves, present high conversion losses, and probable future needs for hydrocarbon raw materials.

10. The picture captions appear to be reversed on p. V-2.

11. On p. VIII-1, it is stated: "If this mix were altered by the elimination of the Federal coal-leasing program, this report finds no measures available which could stimulate an equivalent production potential of alternative energy sources, assuming that anticipated energy production levels are to be maintained".

   How is this statement affected by the Council on Environmental Quality's estimate of energy requirements (discussed earlier in item 3)? What figures for energy production in the absence of Federal coal-leasing were used as the basis for that statement?

12. On p. VIII-60, it is stated: "(I)t may become desirable to locate large coal-conversion plants near large strip mines, where ash and slag from the process would be returned to the open cuts...."

   Disposal of wastes produced by scrubbers presents a widely-publicized problem which might be resolved in this manner.

Director, BLM
Page Four
June 28, 1974

Federal leases could, then, contain a requirement that a lessee operating a strip mine permit and facilitate the placing of ash, slag and other coal-conversion wastes in the bottom of the open cust, if this does not create other adverse impacts.

13. Although ethyl alcohol is described (p. VIII-107) as "a convenient combustible fuel readily usable in motors", the discussion of coal liquefaction (p. VIII-59) is limited to the production of synthetic crude oil. Conversion of coal to alcohol has been suggested as a possibility.

14. The biological energy source options discussed (pp. VIII-105 to -108) are limited to two: production of alcohol from crops and conversion of agricultural organic wastes to oil.

    No data was presented on the amount of energy input required to raise the crops, including fertilizer production. The 14 percent energy replacement figure is, thus, a gross figure; net energy replacement is not estimated.

    Could the residue of the animal waste-to-fuel process be used as fertilizer rather than landfill?

15. No mention was made of the possibility of conversion of metropolitan sewage to gas, although this technology seems to hold great promise. Energy is thereby produced where the most energy is consumed.

Thank you for the opportunity to comment.

Sincerely yours,

Jack Neckels
Director

JN/ds

NORTH DAKOTA STATE PLANNING DIVISION

July 18, 1974

STATE INTERGOVERNMENTAL CLEARINGHOUSE "LETTER OF COMMENT"
ON PROJECT REVIEW IN CONFORMANCE WITH OMB CIRCULAR NO. A-95

To: Department of Interior, Bureau of Land Management

STATE CLEARINGHOUSE PROJECT NUMBER: 7406059257

Mr. Curt Berklund, Director
Bureau of Land Management (723)
18th and C Streets, NW
Washington, D.C. 20240

Dear Mr. Berklund:

Subject: Draft Environmental Impact Statement for the Proposed Federal Coal Leasing Program, Volumes 1 and 2, DES 74-53.

This draft EIS was received in our office on June 5, 1974.

In the process of the A-95 review, the attached comments have been received to date from the North Dakota State Planning Division, the Roosevelt-Custer RC&D, the Lewis and Clark 1805 RC&D, the North Dakota Park Service and the North Dakota Game and Fish Department.

Also enclosed for your consideration is a letter and attachment from Governor Arthur A. Link to Mr. Jack Neckels. This letter and attachment outline North Dakota's position on the federal coal leasing program in the Northern Great Plains.

Because of the complexity and the serious nature of the proposed action, we anticipate further comment on the subject statement and hereby reserve the right to submit additional comments.

Subject to the above comments, this document and attachments constitute the comment of the State Intergovernmental Clearinghouse, made in compliance with OMB Circular No. A-95. Please submit copies of the final environmental impact statement for review.

Sincerely yours,

Miss Bonnie E. Austin
Associate Planner

BEA/da
Attachments

cc: Mr. Edwin Zaidlicz

FROM: STATE INTERGOVERNMENTAL CLEARINGHOUSE
STATE PLANNING DIVISION
STATE CAPITOL
BISMARCK, NORTH DAKOTA 58501

Date Received

ENVIRONMENTAL IMPACT STATEMENT TO BE REVIEWED

TO: Delmont Galyen
Roosevelt-Custer RC&D
Dickinson, ND

ISSUED BY: U. S. Dept. of Interior

DATE: June 5, 1974

NAME OF PROJECT: Draft EIS: Proposed Federal Coal Leasing Program, Volume 2

The attached Environmental Impact Statement is referred to your agency for review and possible comments. If you consider it satisfactory, please check the box labeled, "no comment." Otherwise, please check one of the other appropriate boxes. Your cooperation is asked in completing this memo and returning it to the State Intergovernmental Clearinghouse within 10 days from date of receipt. If no response is received within 15 days of date of notification it will be assumed you have no comment.

☐ No comment
☒ Comments submitted herewith
☐ Meeting desired with applicant

1. Specific comments which are to be attached to the review statement which will be submitted by the State Intergovernmental Clearinghouse: (Use reverse side or separate sheets if necessary)

2. Reasons why meeting is desired with applicant:

Reviewer's Signature: Delmont Galyen
Date:
Title:
Tele:

NDSIC FORM 6 (9/71)

PNRG NO.

FROM: STATE INTERGOVERNMENTAL CLEARINGHOUSE
STATE PLANNING DIVISION
STATE CAPITOL
BISMARCK, NORTH DAKOTA 58501

Date Received

Received
JUL 23 ...
State Planning
Division

ENVIRONMENTAL IMPACT STATEMENT TO BE REVIEWED

TO: Charles Metzger
State Planning Division
Bismarck, ND

ISSUED BY: U. S. Dept. of Interior

DATE: June 5, 1974

NAME OF PROJECT: Draft EIS: Proposed Federal Coal Leasing Program, Volume 2

The attached Environmental Impact Statement is referred to your agency for review and possible comments. If you consider it satisfactory, please check the box labeled, "no comment." Otherwise, please check one of the other appropriate boxes. Your cooperation is asked in completing this memo and returning it to the State Intergovernmental Clearinghouse within 10 days from date of receipt. If no response is received within 15 days of date of notification it will be assumed you have no comment.

☒ No comment
☐ Comments submitted herewith
☐ Meeting desired with applicant

1. Specific comments which are to be attached to the review statement which will be submitted by the State Intergovernmental Clearinghouse: (Use reverse side or separate sheets if necessary)

Will comment at review meeting in July.

2. Reasons why meeting is desired with applicant:

Reviewer's Signature: Charles F. Metzger
Date:
Title:
Tele:

Roosevelt - Custer

RESOURCE CONSERVATION PLANNING & DEVELOPMENT PROJECT
1019 West Villard, Dickinson, North Dakota 58601

June 21, 1974

Response To: U.S. Department of Interior

Subject: Draft EIS - Proposed Federal Coal Leasing Program - Volume 2

Roosevelt-Custer RC&D takes issue with the U.S. Department of Interior's treatment of the following in its Draft EIS - Federal Coal Leasing Program:

(1) We are unable to locate any federal energy policy addressing timing, and sequencing of coal, solar, wind, geothermal, and nuclear energy development in concert with aggressive energy conservation. In the absence of such a federal energy policy, it seems to us that further federal coal leasing could easily be tagged "mismanagement of public resources."

(2) The 20 billion tons of federal coal already under lease plus the 650 billion tons of recoverable coal reserves still untapped in the Midwest and Appalachia (close to where coal mining centers are already located) can provide enough coal energy until the federal energy policy (suggested in our first comment) is developed and adopted.

(3) The Draft EIS does not indicate what the total social costs and benefits to the nation as a whole will be if the coal industry is moved West. The economies and social institutions now present in Appalachia, the Midwest, and the West will be disrupted. In order to make the best resource decision possible, we believe Interior must address this issue in detail.

(4) The Draft EIS does not give adequate attention to the localized problems of rapid population growth or the resulting impact caused by changing an agricultural rural area in the West to industrial urban (within a short period of time). Neither local units of government nor State agencies in the West have the expertise, experience, or money to make accurate assessments of coal related people problems. Therefore these units of government are unable to make long-range policies or plans. The federal government should make available to both state and local governments funds for the hiring of trained personnel knowledgeable in the areas of social planning. This funding should be available before tracts of federal leases are put up for sale, so social impact can be evaluated with the evaluation included in Interior's leasing tract EISs. In addition, those local governments in areas where tracts of federal coal are eventually sold, should be given monies to extend the employment of these social planners through the mining and development phase of the leased federal coal.

(5) Any federal mineral acreage which does not also include surface ownership poses a serious problem which was not addressed by the Draft EIS. Surface owners located above federally leased coal should receive compensation equal to their annual income (plus inflation) off that acreage for every year the surface acreage is being used for mining and until productivity from the surface is restored to its pre-mining level.

FROM: STATE INTERGOVERNMENTAL CLEARINGHOUSE
STATE PLANNING DIVISION
STATE CAPITOL
BISMARCK, NORTH DAKOTA 58501

Date Received

RECEIVED
JUN 18 1974
State Planning Division

ENVIRONMENTAL IMPACT STATEMENT TO BE REVIEWED

TO: R. O. Young
Lewis & Clark 1805 RC&D
Mandan, ND

ISSUED BY: U. S. Dept. of Interior

DATE: June 5, 1974

NAME OF PROJECT: Draft EIS: Proposed Federal Coal Leasing Program, Volume 2

The attached Environmental Impact Statement is referred to your agency for review and possible comments. If you consider it satisfactory, please check the box labeled, "no comment." Otherwise, please check one of the other appropriate boxes. Your cooperation is asked in completing this memo and returning it to the State Intergovernmental Clearinghouse within 10 days from date of receipt. If no response is received within 15 days of date of notification it will be assumed you have no comment.

☐ No comment

☐ Meeting desired with applicant

☑ Comments submitted herewith

1. Specific comments which are to be attached to the review statement which will be submitted by the State Intergovernmental Clearinghouse: (Use reverse side or separate sheets if necessary)

2. Reasons why meeting is desired with applicant:

Reviewer's Signature: Oscar R. Warren Date: 6-17-74

Title: Project Director Tele: 663-6558

Lewis and Clark - 1805

RESOURCE CONSERVATION & DEVELOPMENT PROJECT
Box 236 Mandan, North Dakota 58554 Phone 663-6587

The Executive Council of the Lewis & Clark 1805 Resource Conservation and Development Project has reviewed the EIS and references and comments as follows:

Reference Section III page 12 'livestock forage will be lost':

in 1969	County	No. Farms Reporting	No. Cattle and Calves	Forage in acres *
	Oliver	356	27,110	47,598
	Mercer	973	91,507	65,964
	McLean	910	56,015	82,829
	Totals	2,239	184,632	196,391

* Table 8, 1969 Census of Agriculture - County Data

According to OBERS projections for North Dakota, Table 5, cropland used only for pasture or grazing is projected to increase 2,498,100 acres without transfers from other areas. From Table 2, with the 1969 index as 100, in year 1980, the North Dakota livestock index is projected to be 130. The index for coal mining is projected at 100 in 1969 and in 1980 (Table 2). Table 3 shows North Dakota is projected to produce 220,973,100 more pounds of beef and veal between 1964 and 1980. In dollars, from Table 4, this is projected to be $49,255,100 as a gain. Coal mining, from Table 1, is projected as a $1,057,000 gain from 1969 - 1980 (from 1962 - 1980, $1,390,000 gain).

Since all projects dealing with planning of water resources are to be perceived within the OBERS projections, this agency asks that the change in national policy, of which increased coal mining in North Dakota is a part, reflect this as an impact in order that North Dakota and in particular State Planning Region VII (OBERS Economic Area D96 and Water Resources Area 1013) may continue to carry out its Regional Economic activities as projected in OBERS and is known to be the region's responsibility to the Nation.

Should the OBERS projections fail to be utilized as a base for the United States Department of Interior's proposed Federal Coal Leasing Program, by the Bureau of Land Management, this agency will enter a strong note of protest to the OBERS since North Dakota (and in particular State Planning Region VII of which Oliver, McLean and Mercer Counties are a part) will thus be denied its responsibility and opportunity to meet the Nation's needs as projected in 1972 as the base line.

With less forage for the livestock ordinarily marketed from this region of North Dakota, shall "feed lots" with all attendant costs (including EPA regulation requirements) be cost-shared for the interim between the project and reclamation plus the estimated stabilization time to comparable production prior to project of 4 years as a mitigation? This would seem fair in view of the concurrent food crisis and this agency would expect a response in the EIS.

Among alternatives to the above, which this agency would consider necessary to the mitigation expressed in the EIS is the Department's comment upon income maintenance of the agriculturists affected. This would be expected to parallel the policy currently under review for railroad employees of the Northwestern railroad system which states "income maintenance will prevail at the present level for employees with 5 year tenure, for the employee's lifetime" since their opportunity to work is curtailed by the federal program to reduce the trackage in the Northeast region. Like income maintenance until "reclamation plus 4 years" would mitigate the impact of the project.

Further referencing your Section IV, page 54, as required by 43CFR23, this agency notices that there remains a gap in evaluation and implementation of measures to be taken to prevent or control fire, soil erosion, pollution of surface and ground water, pollution of air, damage to fish and wildlife or their habitat, or other natural resources and hazards to public health and safety.

There is a gap in the CFR to formulate and implement a specific reclamation schedule with consideration being given to grading, soil preparation, and revegetation.

Also noted by this agency is the lack of a design to regulate the method of refuse and overburden disposal, water impoundment, treatment and control, prior to the commencement of operations. This agency has taken notice of performance standards.

This agency asks that the EIS respond with evaluation, implementation of the measures above, formulation and implementation of a specific reclamation schedule; design of the methods of refuse and overburden disposal, water impoundment and treatment and control prior to commencing operations to facilitate the CFR.

Where the EIS comments on the social aspects as in Section V pages 4,6,7,8, and Section VI, pages 4,5, and Section VII, page 8, it is suggested that the circumstances described could be further mitigated by the provision of cultural anthropologists, linguists who speak German, Russian and Scandanavian languages, political scientists and by mental health personnel skilled in dealing with cultural impacts at all project operations here in North Dakota. These should be available to the communities prior to and continuing throughout the life of the project, possibly from IPA, but certainly at the federal expense since the project is in response to federal policy of self-sufficiency of energy production.

In addition, since the migrant population will be that described in your Section VI, page 5, this agency asks that the EIS commit the Department of Interior, with whatever cooperation from other federal departments are necessary, to assist both that migrant population and the nuclear communities, they will join in 'life space' with a schedule of grants, funding, impact cooperation prior to project commencement, funding the provision of utilities, facilities and housing as well as the normal federal funding of impacts to schools by federal projects. This is seen, by this agency, to be in concurrence with the stated goals of the Departments of Agriculture and Housing and Urban Development.

FROM: STATE INTERGOVERNMENTAL CLEARINGHOUSE
STATE PLANNING DIVISION
STATE CAPITOL
BISMARCK, NORTH DAKOTA 58501

Date Received

JUN 10 1974

North Dakota Park Service

ENVIRONMENTAL IMPACT STATEMENT TO BE REVIEWED

TO: Einar Johnson
Park Service
Mandan, ND

ISSUED BY: U. S. Dept. of Interior

DATE: June 5, 1974

NAME OF PROJECT: Draft EIS: Proposed Federal Coal Leasing Program, Volume 2

The attached Environmental Impact Statement is referred to your agency for review and possible comments. If you consider it satisfactory, please check the box labeled, "no comment." Otherwise, please check one of the other appropriate boxes. Your cooperation is asked in completing this memo and returning it to the State Intergovernmental Clearinghouse within 10 days from date of receipt. If no response is received within 15 days of date of notification it will be assumed you have no comment.

☐ No comment

☒ Comments submitted herewith

☐ Meeting desired with applicant

1. Specific comments which are to be attached to the review statement which will be submitted by the State Intergovernmental Clearinghouse: (Use reverse side or separate sheets if necessary)

2. Reasons why meeting is desired with applicant:

Reviewer's Signature: Einar L Johnson

Date: 6-11-74

Title: Director

Tele:

A. We believe the proposed revision of 43 CFR, Part 23, Sec.23.0-5C, Operator 1 (vi) is too vague and recommend it be more specific such as: "A statement of the proposed manner and time of performance of work to reclaim disturbed areas to a condition equal to or better than original productivity." "This reclamation to be done without the benefit of additional fertilizer or irrigation."

B. A section is needed on the surface rights of landowners. The surface rights are as important, if not more so, than the subsurface rights of landowners. Use of the land surface is of value now and will be critical for future generations after the subsurface coal minerals are removed.

NDSIC FORM 1 (9/71)

PNRC NO.

Date Received

RECEIVED
JUN 13 1974
State Planning
Division

FROM: STATE INTERGOVERNMENTAL CLEARINGHOUSE
STATE PLANNING DIVISION
STATE CAPITOL
BISMARCK, NORTH DAKOTA 58501

ENVIRONMENTAL IMPACT STATEMENT TO BE REVIEWED

TO: Mr. Russell Stuart
State Game and Fish Dept.
Bismarck, ND

ISSUED BY: U. S. Dept. of Interior

DATE: June 5, 1974

NAME OF PROJECT: Draft EIS: Proposed Federal Coal Leasing Program Volume 2

The attached Environmental Impact Statement is referred to your agency for review and possible comments. If you consider it satisfactory, please check the box labeled, "no comment." Otherwise, please check one of the other appropriate boxes. Your cooperation is asked in completing this memo and returning it to the State Intergovernmental Clearinghouse within 10 days from date of receipt. If no response is received within 15 days of date of notification it will be assumed you have no comment.

☐ No comment

☒ Comments submitted herewith

☐ Meeting desired with applicant

1. Specific comments which are to be attached to the review statement which will be submitted by the State Intergovernmental Clearinghouse: (Use reverse side or separate sheets if necessary)

2. Reasons why meeting is desired with applicant:

Reviewer's Signature: [illegible] Date: [illegible]

Title: [illegible] Tele:

STATE OF NORTH DAKOTA
EXECUTIVE OFFICE
BISMARCK

ARTHUR A. LINK
Governor

RECEIVED
MAY 17 1974
State Planning
Division

May 15, 1974

Mr. Jack Neckels, Director
State Planning Division
State Capitol
Bismarck, North Dakota 58501

Dear Jack:

Enclosed is a letter to Mike Harvey, Interior and Insular Affairs Committee, outlining the position of the State of North Dakota on the Federal coal leasing program in the Northern Great Plains.

You will note that the positions of North Dakota and Montana are very similar on this matter of critical importance to the two states.

Sincerely yours,

Arthur A. Link

ARTHUR A. LINK
Governor

AAL:mk

Enclosure

STATE OF NORTH DAKOTA
EXECUTIVE OFFICE
BISMARCK

ARTHUR A. LINK

May 15, 1974

Mr. Mike Harvey
Interior and Insular Affairs Committee
United States Senate
3106 Dirksen Senate Office Building
Washington, D. C. 20510

Dear Mr. Harvey:

This letter represents the position of the State of North Dakota concerning the leasing of federal lands to surface mine for lignite and other mineral resources in the State of North Dakota. Please include this letter in the printed record of the hearings conducted on the Federal coal leasing program in the Northern Great Plains.

Many of the controversial issues presently facing North Dakota relate to the management and utilization of this state's lignite resources. The extent of lignite utilization in North Dakota could determine whether North Dakota will retain its primarily agricultural character or whether it will become a center of energy-related industrialization and urbanization. Related thereto is the extent the air and water quality in this state will be degraded; the loss in agricultural and wildlife productivity of surface-mined land; the economic impact of lignite utilization; and the impact of these developments on our entire quality of life.

As the total impact of lignite utilization in North Dakota depends to a great extent upon the impending decisions on coal leasing by the federal government, I wish to make the following recommendation on the federal leasing program:

a. Consistent with Montana's "Preliminary Statements of Position," for at least the first initial five years of the EMARS (Department of Interior's Energy Minerals Allocation Recommendation System) coal leasing program, North Dakota people and their government would assent to federal leasing of coal only if its combustion or conversion would take place near the nation's high demand areas. Exception: When the State of North Dakota, through the State Water Commission and/or any other appropriate agency, has expressly authorized the construction of an electrical generation plant, a gasification plant, or other energy-conversion facility within this state or when such a facility already exists, it is recommended that the leasing of federal lignite be permitted so as to enable the authorized energy-conversion facility to obtain a contiguous "block" of mineable lignite.

Leasing lignite for use at the load centers only in the initial period will allow necessary evaluation of the consequences of mine-mouth industrialization in North Dakota and will permit more definitive research on the little-known cumulative impacts of such industrialization.

b. All federal lignite leases should require as a minimum compliance with all federal/state laws and regulations (viz., environmental protection legislation and legislation concerning severance and land disturbance taxes which may be imposed by the state.

Mr. Mike Harvey
Page Two
May 15, 1974

c. Federal lignite leasing should proceed in North Dakota only after all resource values and land uses have been very thoroughly inventoried and the mining plan thereon jointly approved by the federal/state governments. Although the state may have impliedly recommended federal leasing within a certain area by the grant of a water permit or other appropriate authorization for an energy conversion facility, it is certain that not all land should be surface mined. An inventory is necessary to ascertain whether certain land must not be surface mined because of poor reclamation potential, unique aesthetic value, etc. This "selective denial" concept is critical to sound resource management; the historic method of federal leasing only in the areas of greatest corporate interest should not be resumed.

d. All federal leases must provide maximum protection to the surface owner. The federal government should ensure adequate compensation to the surface owner for permanent loss of land or temporary displacement from the mined land and the reduced agricultural productivity following mining/reclamation operations.

The State of North Dakota desires to assist in the effort to meet the "energy needs" (to be distinguished from mere "energy demands") of the nation. But, concurrent with the offer of assistance, this state will demand that necessary environmental, social, and economic safeguards to protect the state. North Dakota will not "subsidize" the energy needs of the rest of the nation by bearing a disproportionate share of the social and environmental costs of massive energy production.

The decisions the federal government is considering may have a profound influence on the future of North Dakota. Therefore, the involvement of this state in the decision-making process is critically important and necessary for any equitable decision on federal lignite leasing in this state. Your consideration of the matters contained in this letter is appreciated.

Sincerely yours,

ARTHUR A. LINK
Governor

AAL:mk

cc: Secretary Rogers C. B. Morton
Secretary Earl L. Butz
Senator Milton R. Young
Senator Quentin N. Burdick
Senator Lee Metcalf
Representative Mark Andrews
Governor Thomas L. Judge
Governor Stanley K. Hathaway
Mr. Ed Zaidlicz
Mr. Dan McIntyre
Mr. Jack Neckels

State of Montana
Office of The Governor
Helena 59601

THOMAS L. JUDGE
GOVERNOR

August 21, 1974

Mr. Curt Berkland, Director
Bureau of Land Management
Attention: 720, U.S. Department
of the Interior
Washington, D. C. 20240

Dear Mr. Berkland:

I take great exception to the thrust, contents and conclusions of DES 74-53 on the Proposed Federal Coal Leasing Program. The attached comments represent the consensus of the Governor's Montana Energy Advisory Council, which is comprised of ten social and natural resource agencies and chaired by Lieutenant Governor Bill Christiansen. I concur with this critique and expect that you will treat it as the formal response of Montana state government.

On page I-207, it is concluded that "Excluding Alaska again, it is apparent that interest in future federal coal leasing will generally focus around coal deposits in Montana, Wyoming, Utah and Colorado and to a lesser extent, North Dakota and New Mexico" (emphasis added). I trust that you recognize our comments as more than an academic review. We are dealing with a document that we fear will veritably shape the future of our state--specifically the fate of a way of life we treasure and of the use and enjoyment of Montana's high quality water, land and air resources. We expect that our views will be heavily weighted in preparation of subsequent impact analyses and will be incorporated into resulting federal policy.

As you will note, we think the inadequacies of this statement are too great to be corrected by minor revision as a final EIS is prepared. Lengthy discussions on the impacts of mine mouth industrialization must be prepared before resumption of federal coal leasing can be honestly considered. Montana suggests resubmission of an adequate, unbiased [illegible] draft statement.

Sincerely,

THOMAS L. JUDGE
Governor

August 14, 1974

MONTANA'S CRITIQUE OF DES 74-53

OVERVIEW

The Montana review of DES 74-53 has been organized under the following headings.

I. DES 74-53 FAILS TO ADEQUATELY ADDRESS THE MAJOR ISSUES OF COAL DEVELOPMENT IN THE NORTHERN GREAT PLAINS.

II. DES 74-53 DOES NOT MEET THE REQUIREMENTS OF THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA).

III. DES 74-53 EMBODIES CONTROVERSIAL AND QUESTIONABLE ASSUMPTIONS TO JUSTIFY DECISIONS TO EXPAND FEDERAL COAL LEASING.

IV. DES 74-53 DISREGARDS MONTANA'S EXPRESSED VIEWS REGARDING THE PROPRIETY AND SUBSEQUENT IMPACTS OF FUTURE FEDERAL COAL LEASING DECISIONS.

V. CONCLUSION.

I. DES 74-53 FAILS TO ADEQUATELY ADDRESS THE MAJOR ISSUES OF COAL DEVELOPMENT IN THE [illegible] GREAT PLAINS.

Page V-1 of the DES states: "The major environmental issue is essentially whether or not an orderly system of lease allocation and potential subsequent development is environmentally superior to unregulated leasing."

- 2 -

Suggestions that coal development can be conducted on any basis other than on "orderly" one are among the most rhetorical of all coal-related questions. "Orderly" development is certainly preferable to leasing predicated solely on corporate demand.

The real issues include the following.

A. Is an expanded federal coal leasing program necessary in light of alternative national energy consumption patterns and the existence of numerous, massive and undeveloped coal resources now under lease to private concerns?

B. What levels and types of coal-based industrialization are likely to follow coal leasing? Are derivative coal-based industries appropriate for the Northern Great Plains area? If so, at what sites will such coal-based industries be located; at what social, economic and environmental costs? Who is to bear the burden of such development costs?

C. Are the nation's energy demands best met by Project Independence and the resultant massive exploitation of irreplaceable natural resources?

D. Is the massive shift from eastern and midwestern coal to western coal really necessary or economically responsible on a national basis? Will coal production shifts create western boom town situations eventually balanced only by unemployment and "bust" situations in historic coal production regions?

These central issues have been either ignored or addressed only superficially in DES 74-53.

II. DES 74-53 DOES NOT MEET THE REQUIREMENTS OF THE NATIONAL ENVIRONMENTAL ACT (NEPA).

DES 74-53 does not meet the requirements of NEPA in that impacts beyond and resulting from strip mining and utilization of federal coal reserves are essentially unaddressed. The coal almost inevitably will be burned to fire steam generating plants in the short range or gasified in the more distant future. Environmental and social impacts of such coal utilization are direct consequences of leasing and mining federal coal.

NEPA clearly provides in Section 103(2)(c)(iv) that environmental impact statements will address "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." [illegible] The [illegible] consequences of large-scale [illegible] coal leasing are barely addressed in either the natural resource or the socio-economic discussions.

The CEQ Guidelines further provide:

- 3 -

Section 1500.6	Identifying major actions significantly effecting the environment.
(b)	Significant affects also include secondary effects, as described more fully in Section 1500.8(a)(3)(ii).
Section 1500.8(a)(3)(ii)	Secondary or indirect, as well as primary or direct, consequences for the environment should be included in the analysis. Many major Federal actions, in particular those that involve the construction or licensing of infrastructure investments (e.g., highways, airports, sewer systems, water resource projects, etc.) stimulate or induce secondary effects in the form of associated investments and changed patterns of social and economic activities. Such secondary effects, through their impacts on existing community facilities and activities, through inducing new facilities and activities, or through changes in natural conditions, may often be even more substantial than the primary effects of the proposed original action itself. For example, the effects of the proposed action on population and growth may be among the more significant secondary effects. Such population and growth impacts should be estimated if expected to be significant and an assessment made of the effect of any possible change in population patterns or growth upon the resource base, including land use, water, and public services, of the area in question.

Discussion of even the primary mining-related, socio-economic impacts of coal development in DES 74-53 is, at best, superficial. Major secondary effects are almost totally ignored, insofar as Interior has not discussed likely coal-based, mine-mouth industrialization (e.g., coal gasification, coal liquefaction, coal-fired steam generation plants, dams and aqueducts) that are likely to follow resumption of federal leasing and wholesale coal mining. Allusions to the generation of great wealth for all (e.g., ". . . nearly double the present personal income . . .." page III-76, 77) are misleading. As documented below, the list of impact effects presented is brief and disproportionately weighs the beneficial aspects.

A. While population influx as a result of coal development is acknowledged and briefly discussed, the effects of population fluctuation and subsequent out-migration are ignored. Population density and population fluctuation have social, economic and environmental effects, many of them undesirable.

- 4 -

B. The possible effects of population influx upon existing local and regional, economic and social systems are not addressed. Problems such as labor competition, boom and bust cycles, economic sector incompatibilities, effects on government services and disruption of established social organizations are potential consequences that should not and cannot be ignored.

C. Widespread effects of altering existing settlement and land use patterns are not discussed.

D. Mitigation of neither the cumulative nor the long-term effects on social or economic systems is considered beyond brief allusions to the time it may take for land reclamation. This omission is of great concern, particularly in light of the administration's perception of western coal as a stop-gap solution to the nation's "energy ills." The scope of the statement is extended only to 1985. Yet, coal leasing decisions and the processes they set in motion will commit the nation and the Northern Plains Region to a course of far greater than ten years duration. The start-up time alone for high BTU coal gasification facilities approaches ten years.

E. At several points (e.g., pages I-10, 11), the statement indicates that data on resources and impact effects are badly needed. Yet, the authors conclude (page I-11) that:

> "Action programs adequate to meet critical energy needs must proceed further and faster than many would like, and certainly far in advance of our ability to completely analyze all of the complex cause and effect relationships that are involved."

This conclusion is consistent with neither the letter nor the intent of NEPA.

F. Many critical socio-economic considerations are inextricably linked to potential disruption of natural systems.

Whether Montana retains its primarily agricultural character or becomes a center of industrialization and urbanization is largely dependent on coal use questions that in the DES are avoided or only briefly addressed. If the relationships are to be properly addressed and NEPA complied with, a new draft environmental impact statement must be prepared.

With regard to the Northern Great Plains area, the new draft must adequately address the potential cumulative consequences of coal-based industrial development upon all other competing uses (present and future) of the region's surface and underground water supplies and upon the region's high quality airshed.

The resubmitted impact analysis should specifically consider the future of the Northern Plains' agricultural industry as influenced by possible dewatering of streams, and the depletion or contamination of subsurface aquifers. Further,

- 5 -

he present draft shows considerable bias by down playing the significance f trace metals dispersed by coal conversion facilities. Page I-45 notes:

> "When coal is burned, most of these elements are concentrated in the coal ash, but a few of the more volatile elements are emitted into the atmosphere."

n adequate and candid DES would note that some of the most toxic trace eleents (mercury, flourine arsenic and selenium) are most likely to be emitted n or with stack gases.

II. DES 74-53 EMBODIES CONTROVERSIAL AND QUESTIONABLE ASSUMPTIONS TO JUSTIFY ECISIONS TO EXPAND FEDERAL COAL LEASING.

A. Among the implicit assumptions underlying DES 74-53 is a commitment to Project Independence (although not acknowledged by name) (pages I-5, 8), a wish ". . . to go beyond production for domestic consumption" (page I-9), and a desire to provide "third world" countries with energy supplies and thereby offset the political and economic power of the oil rich nations (page I-8).

An overriding concern relates to the degree to which a series of tremendously important decisions is being made with a minimum of assessment, limited public review and no congressional approval. Project Independence, an Administration proposal which is intended to achieve national energy self-sufficiency by 1980 and energy export capability thereafter, is foremost. Indications are that such goals are not attainable in light of a variety of resource, economic and technological constraints. Furthermore, because of the massive social and environmental impacts that are associated with attempting to reach these goals, it is very possible that national costs may outweigh the gains.

Before this nation commits itself to the vague concepts of Project Independence, much more public review is necessary, and the decision to proceed should be made only if congressional approval is given. This, however, is not the case. As indicated in the impact statement, decisions have been made to proceed rapidly, disregarding the inadequate information concerning broad implications. This unquestionably is an improper way to make resource decisions of national and long-term significance.

B. The draft assumes (pages I-27, 28) that national energy consumption will grow at an average annual rate of 3.6 percent. Yet, given higher energy prices and a growing public awareness of the need to conserve energy, it is doubtful that energy use will accelerate beyond the "slightly more than 3 percent" that prevailed from 1947 to 1971.

- 6 -

The projection cited for future energy demand is but one of several equally possible energy futures. For example, the Ford Foundation Energy Policy Project (Exploring Energy Choices - A Preliminary Report) presents three feasible national energy futures. These are:

1. Historical Growth Scenario -- assuming energy use will continue to grow much as it has in the past.

2. Technical Fix Scenario -- assuming a similar level and mix of goods and services, but with a slower rate of energy growth -- about one-half as high as in the historical growth scenario -- resulting from a national effort to reduce energy demand through energy conservation.

3. Zero Energy Growth Scenario -- assuming a deceleration in demand such annual energy consumption in the year 2000 would be just over half that required if the historic rates of energy growth continue. (100 quadrillion BTU vs. 185 quadrillion BTU).

The Ford Project maintains that all three scenarios are feasible, both technically and economically, without severe disruptions in the quality of life in the United States. The Technical Fix Scenario, in particular, posits considerable energy demand reduction by focusing national policy and attention upon efficiency of energy conversion and use rather than upon increasing the supply of energy.

The State of Montana recommends that the Administration and Congress consider more than one energy future in deriving a national coal policy, particularly since the economic, social, environmental and technological results of that policy will be of great significance and long duration. DES 74-53's inadequate assessment of "growth alternatives" fails to meet NEPA standards.

C. It is assumed (page I-8) that "for each one percent rise in domestic energy consumption, we will have to import an additional five million barrels per day, or produce an equivalent amount of synthetic crude from domestic coal or oil shale."

Yet, present total national energy consumption is reportedly the equivalent of 34.5 million barrels of oil per day. One percent of 34.5 million is only 345,000. Thus, the assumption in question seems to exaggerate the need for expanded federal coal leasing by a factor of fourteen.

D. Bureau of Mines projections (page I-199) that 36 coal gasification plants will be in operation by 1985 are presented as fact. Yet, ten years (page I-207) may be required to move from lease acquisition to production of synthetic natural gas (SNG) and only a few companies have made definite commitments to even explore the possibility of constructing such huge facilities.

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Assuming that 36 SNG plants will require that 11.5 billion tons of coal reserves be set aside (page I-199) seems even more unrealistic when one considers that no commercial process is available for converting Lurgi SNG into a high BTU product that can be interchanged with natural gas.

Through our involvement with the Northern Great Plains Resource Program, we are aware of the Bureau of Mines' methodologies used in projecting needs for the 11.5 billion ton gasification reserve and a similar 3.2 billion ton reserve (page I-199) for electrical power plants. The Bureau essentially ignores price-demand elasticities as a check on growth in consumption and as a brake on demands for new energy sources.

Work by competent, dispassionate, non-federal researchers is showing that there is, in fact, no lack of price responsiveness in energy use or production. These research results are at sharp variance with previously published figures from the energy industries and related federal agencies.

In U.S. Energy Through the Year 2000, the Department of the Interior estimates that natural gas production in the U.S. will be 12.7 percent greater in 1985 than in 1971, while U.S. production of synthetic gas will by 1985 be almost ten percent of natural gas production. Yet, the Ford Energy Policy Project report completed last year by Resources for the Future indicates that at wellhead prices of 60¢ to 90¢ per thousand cubic feet, U.S. production of natural gas would increase 400 percent if that much were demanded. Restated, natural gas production could quintuple at prices well below projected coal gasification costs.

The potential for production of other synthetic fuels from coal may also be overrated. In the June 17, 1974, Weekly Energy Report, Henry Linden, Director of the Institute of Gas Technology is quoted as follows:

> "The initial estimates that we saw for making methanol from coal were $1.50 to $2.00 per million BTU. We have just done a study of our own which shows that, under current conditions, this has probably doubled."

Demand-price elasticities also must be considered. Clearly, at prices sufficient to stimulate large production of synthetic gas and methanol, demand would be substantially reduced.

Because such enormous differences exist between federal projections, on which policy is being made, and the growing bulk of independent estimates, and because similar discrepancies exist regarding use and production projections for electrical energy, Montana believes that the SNG and power plant coal reserve data are improperly advanced to justify a crisis program of federal coal leasing.

E. In several places (e.g., page I-10), the DES assumes adequate mined land reclamation to be established fact. In reality, adequate long-term land reclamation has yet to be demonstrated on arid and semiarid western lands. While some revegetation has been accomplished in Montana, no

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revegetated area has been subjected to sustained grazing. Revegetation is only an intermediate part of the reclamation process. It is not known if the newly established cover will be self-sustaining and productive under continued use.

F. DES 74-53 seems to assume that western reserves provide the only source of low sulfur coal in sufficient quantity to meet air quality standards and still alleviate the "energy shortage". The draft statement notes extensive coal tonnages under western lands, but does not adequately discuss the comparative net energy gains of western versus eastern and midwestern coal operations. Western reserves must first be discounted by the ratio of western and "eastern" BTU contents. The fractional discount, according to Hittman Associates (consultants to the Dept. of Interior) is on the order of 8.5/11.5, or a 26 percent reduction in available heat.

Power plant sulfur emission standards are rationally established on a pounds of sulfur/million BTU basis -- not on the basis of sulfur content per ton of coal. Accordingly, to compare eastern and western coals on an equitable BTU basis, western sulfur contents must be increased by the approximate ratio of 11.5/8.5.

Most western coal reserves lie at considerable distances from projected centers of energy consumption. Whether energy from western coal is moved to the consumer in unit trains, or long distance gas pipelines or electrical transmission lines, considerable will be lost or consumed in transmission, in construction of transmission facilities or in shipment of the coal itself.

Further, there is abundant low sulfur coal east of the Mississippi. For example, the U.S. Bureau of Mines estimates that West Virginia alone has 47.5 billion tons of bituminous, low sulfur reserves. With its superior quality and heat content it represents a great energy source close to eastern markets.

The rationale of utilizing abundant low sulfur western coal to alleviate the air quality problem thus has a questionable base and, in fact, appears to be an attempt to justify a massive east-west shift.

IV. DES 74-53 DISREGARDS MONTANA'S EXPRESSED VIEWS REGARDING THE PROPRIETY AND SUBSEQUENT IMPACTS OF FUTURE FEDERAL COAL LEASING DECISIONS.

On March 22, 1974, Governor Thomas Judge released Montana's preliminary position statement on federal coal leasing to officials of the Bureau of Land Management and the U.S. Forest Service. Agreement among state agencies on the contents of the statement was unanimous. Thus, the document is "preliminary" only because of the [illegible] need for [illegible] public review and [illegible]. [illegible] response through numerous hearings and [illegible] has been overwhelmingly favorable. A copy of the preliminary Montana position is attached as Appendix A.

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DES 74-53 is contrary to or ignores at least four of the five preliminary statements of position included in Governor Judge's preliminary policy statement on federal coal leasing. Following are several examples.

A. Montana preliminary position IV(A) states:

> "For at least the initial five years of the EMARS coal leasing program, Montana people and their government would assent to leasing of coal only if its combustion or conversion will take place near the nation's high energy demand areas. Consequently, both the lease terms and the characteristics of the coal deposits chosen for lease should dictate that the coal will be burned or converted at load centers.
>
> This position can be modified only if it can be clearly shown that mine mouth industrialization is necessary to meet state needs."

The federal government's position on location of combustion or conversion plants is quite vague. Indeed, the issues are largely avoided as evidenced by the following statement (DES, page I-6):

> "Neither coal utilization nor the costs and benefits of coal mining technology are treated."

It is very difficult to comprehend how "the off-site environmental impacts of coal mining under federal leases" can be discussed without full consideration of coal utilization alternatives, especially when the energy crisis and air quality standards are given as rationales for stepped-up leasing.

B. Section IV(B) of Montana's position paper states:

> "If expanded federal coal leasing is to proceed in Montana, determinations and allocations of acreage and tonnage to be leased should be minimized in recognition of the 1.7 billion tons of federal coal currently under lease in Montana, extensive Indian coal leases, the 32,775 acres of state coal under lease, and the vast reserves of privately owned coal committed to development."

As discussed in Section I of this critique, DES 74-53 should clearly address whether federal coal should be subject to accelerated leasing, and if so, how much coal should be leased, where, and at what rate? Yet, the statement's description of the proposed EMARS coal leasing program (pages I-1 through 5) is totally unquantified. The reviewer is given no numerical base from which to evaluate the critical how much, when, where and how fast questions that are at the root of impact evaluation.

On page I-6, it is noted that "the statement is limited to the effects of actions that occur on Federal lands or where privately owned surface is underlain by Federal coal resources . . . ." Since considerable federal coal is checkerboarded with non-federal coal, the rewritten draft statement should detail the anticipated effects of federal leasing on private, Indian and state held surfaces and minerals.

C. Preliminary position statement IV(C) says:

> "If expanded federal coal leasing is to proceed in Montana, all new federal coal leasing should reference and require compliance with the Montana Strip Mine Siting Act, Strip Mining and Reclamation Act, Utility Siting Act, Coal Conservation Act, and Water Use Act."

The only mention of state standards is on page I-160.

> "Department policy requires that mining and reclamation plans . . . must comply with the reclamation requirement of the relevant state."

No further mention of integration of federal leasing with state objectives is made. In addition, no formal arrangement has ever been made to implement the above policy. If political conditions dictated, that "policy" could be modified easily by the federal government. A far stronger commitment is needed.

Lease provisions themselves are never fully discussed and the alternative of modifying the lease provisions that currently exist is virtually ignored.

D. Section IV(D) of the preliminary Montana position paper states that:

> "If expanded federal coal leasing is to proceed in Montana, it should proceed exclusively in those areas where all resource values and land uses have been thoroughly inventoried."

In contrast, page I-11 of the draft environmental impact statement states (and we repeat the quotation) that:

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> "Action programs adequate to meet critical energy needs must proceed further and faster than many would like, and certainly far in advance of our ability to completely analyze all of the complex cause and effect relationships that are involved."

DES 74-53 provides no cogent explanation of why such haste and acceptance of unknown risks are needed. Given the 15 billion tons of recoverable federal coal already leased, in addition to all of the state, Indian and private coal leased, it would seem that many years are available for more thorough planning based on adequate resource data.

E. Section V(E) of the Montana position paper says:

> "The market place and economic considerations should not be the primary factor in selecting lands for lease."

The environmental impact statement ignores Montana's view. For instance, page I-3 states:

> "The allocation of Federal coal resource areas will be on the basis of least cost of delivered energy." (Emphasis added.)

Page I-128 adds:

> "The Secretary is authorized to divide any of the coal lands . . . into leasing tracts . . . which will permit the most economical mining of coal." (Emphasis added.)

Although monetary return has to be a factor in leasing, other concerns must also be given at least equal consideration. These include environmental issues, projected land uses, social considerations and other economic factors, such as the effect of the east-west mining shift on the economies of both parts of the country.

V. CONCLUSION.

The following is a summary of Montana's concerns and recommendations regarding DES 74-53

A. It appears that the internally-imposed constraints under which DES 74-53 was written largely prohibit a meaningful analysis. The constraints reflect administrative intentions which are not necessarily concurred in by the

broadly representative electorate. In many instances it seems that the department is implementing coal-related aspects of Project Independence without congressional review.

A related consideration concerns the policy-setting nature of the leases themselves. Do the leases' provisions enable the lessee to effect such basic land use changes as the creation of company towns? If such 1967 lease provisions are kept, the department again would be establishing land use policy. Yet, consideration of this most significant type of impacts is not apparent. A serious shortcoming of the statement is its failure to provide meaningful impact evaluation of current leases as well as those that can be anticipated in the future.

In view of the limited scope of assessment, the conclusions reached are inappropriate. The federal coal leasing program will obviously have profound primary and secondary impacts upon Montana and other states in the Northern Plains Region. A meaningful evaluation of the federal situation must be made in the context of coal leasing upon all lands. It is particularly disconcerting that the cumulative implications of the coal conversion processes are not thoroughly addressed, for these pose perhaps the most significant environmental, social and economic impacts of coal development. The leasing of coal is inextricably related to site-specific energy conversion impacts. These considerations deserve more than a cursory examination.

B. It is noted that the leasing policy will reflect ". . . the highest environmental ethic . . ." (I-1) and "assure maximum environmental protection" (I-137). Statements of this nature can be found throughout the document; yet there is real concern as to whether environmental considerations can and will be fully weighed.

In this context, the statement should clearly indicate whether or not Interior's cost accounting will include the internalization of previously externalized costs. Montana urges that all environmental, social, economic and energy costs be entered on the debit side of the energy delivery cost equation.

C. Montana seriously doubts the short to medium term necessity of an expanded federal coal leasing policy. On the basis of presently available information, it appears that the present coal leasing moratorium should continue until all options have been fully evaluated in public.

1. At the present time, over 15 billion tons of recoverable public coal and at least 5 billion tons of Indian coal have been leased upon nearly 1 million acres. This amounts to 35 times the tonnage of U.S. Coal produced in 1973. 1/ (The Northern Plains Resource Council notes that this estimate is probably low in that the 183,167 acres leased on the Northern Plains are known to contain 14.6 billion tons.)

1/ Cannon, James. Leased and Lost, A Study of Public and Indian Coal Leasing in the West. Economic Priorities Report 5(1), Council on Economic Priorities, 1974, p. 4.

2. Of the present 474 public and Indian coal leases in seven western states, only 11 percent are now producing. The 54-year old federal coal leasing program has yielded less than one percent of the nation's coal production. 2/

3. As evidenced by the following, the Department of the Interior concedes that there is a paucity of information concerning the role of coal in the national energy picture.

> "Many of the details of resource inventory and economic analysis necessary to accurately assess what portion of the national energy shortage should be supplied from increased coal production are inadequate, out of date, or not available in usable form." (I-10)

On the basis of statements such as these, we seriously question a need for an expanded federal coal leasing program. In the absence of a substantive justification or a clearly defined national coal development policy, federal coal leasing should continue to be held in abeyance. The following statement by the Council on Economic Priorities generally indicates the posture we should assume at this time.

> "The nation has enough coal to take a breather and make some plans. Over 650 billion tons of recoverable coal reserves are still untapped in the Midwest and Appalachia. There are 20 billion tons of coal already under lease in the west, not including privately or state owned coal. Much of the coal is readily accessible. The nation should not act in haste or panic, because the leisure in which to repent will be long indeed." 3/

D. In light of the very questionable necessity for large-scale coal exploitation, we object to the apparent willingness by Interior to engage in activities that will require poorly defined mitigating measures. Section IV of the statement, "Measures to Mitigate Environmental Impacts," ostensibly ". . . describes measures and techniques that lessen or eliminate impacts."

This section implies that expanded coal leasing is truly necessary and that leasing impacts can, in fact, be adequately controlled. Neither implication has been justified. In fact, neither the degree of control of leasing activities nor the level of mitigation of effects has been quantified.

/ Ibid., p. 4.

/ Ibid., p. 11.

E. At several points throughout the statement (most obviously on pages IV-4 and 5), the economic virtues of coal development are extolled. Yet, the statement does not begin to address the full range of primary and secondary socio-economic effects of an expanded federal coal leasing program. It is difficult to understand how Interior can discuss benefits of coal development without having first analyzed and documented all the costs and benefits of that development.

DES 74-53 betrays a marked insensitivity to or misunderstanding of the nature of Montana's perceptions of coal development and the highly touted "changes" that coal development will bring. This observation holds for the DES 74-53 portrayal of Indian perceptions of the nature of coal development. Contrary to the statement that Montanans are divided along geographical boundaries concerning the acceptability of coal development, we have displayed a substantial consensus in our insistence that development proceed cautiously, if at all.

Finally, examination of preliminary socio-economic research conducted in the Northern Great Plains area (much of it conducted under auspices of the Northern Great Plains Resource Program) will indicate that many of the promised benefits of coal development are illusory, at the development area level. Some of that NGPRP work documents social and economic costs attendant to coal development. We recommend the NGPRP Socio-Economic Work Group report to Interior as a preliminary account of economic and social costs of coal development.

F. On the basis of the foregoing discussion, we feel that the draft statement has fallen short of providing valid assessment. It assesses a situation involving pervasive and far-reaching impacts in a superficial way. In effect, DES 74-53 is a program justification statement that, due to its enormity and organization, is difficult to assess. If the long-term public interest is to be served, there must be a more cogent, purposeful analysis. There must be far greater emphasis upon the coal leasing program itself with a quantification of exactly what actions are proposed. A cosmetic rewrite of DES 74-53 will not suffice. We strongly urge that the U.S. Department of the Interior resubmit an objective draft statement that fulfills the requirements and intent of NEPA.

STATE OF MONTANA
PRELIMINARY POSITION STATEMENT

Coal Development, With Particular Regard To The Leasing of Federal Coal From the Decker-Birney Planning Area Under the EMARS Program

I. INTRODUCTION

Many of Montana's most controversial issues relate to the potential development of the Fort Union Coal resource. Whether Montana retains its primarily agricultural character or becomes a center of industrialization and urbanization is largely dependent on the types and levels of development. Impending decisions on coal leasing by the federal government could have a tremendous impact on our state.

II. PERSPECTIVE

In May of 1972, the Bureau of Land Management (BLM) and the Custer National Forest, U. S. Forest Service (USFS), in cooperation with the State of Montana, began compiling data on the major resources and the social and economic features of the 900,000 acre Decker-Birney area located in Southeastern Montana. Over thirty-one percent (285,000 acres) of the study area is underlain by strippable coal, and conservative estimates of these reserves total 15,900,000,000 tons.

The study, now nearing completion, is intended to provide BLM and USFS with a foundation of knowledge on which sound resource decisions can be made, in considering the many conflicting values and capabilities of the area. Both BLM and USFS are preparing multiple-use plans for the lands under their respective jurisdictions.

On March 6, 1974, BLM and USFS officials met with the Montana Energy Advisory Council (MEAC) to report on the status of this study. Details of coal and other resource inventories were discussed in light of pending federal coal-leasing programs.

The Department of Interior's Energy Minerals Allocation Recommendation System (EMARS) will probably be finalized within the next few months. At that time, state and local BLM offices will be informed of EMARS lease allotments, the magnitude of which are presently unknown. The Montana BLM Office is likely to be instructed to commence leasing of federal coal by or before January of 1975, in accordance with the EMARS program allotment.

At the same meeting, the following requests were made of MEAC:

A. An articulation of Montana's land use, socio-economic, and environmental protection goals and objectives.

B. Baseline socio-economic data of the Decker-Birney area.

C. An analysis of likely environmental and/or socio-economic impacts of the proposed Decker-Birney development alternatives.

D. Possible legal and administrative tools available to foster plan implementation and needed enforcement requirements.

E. Possible recommendations to improve the decision-making process, goals and objectives formulation, and plan implementation and enforcement.

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E. Possible recommendations to improve the decision-making process, goals and jectives formulation, and plan implementation and enforcement.

This Preliminary Policy Statement is directed to the first of those requests. It lates Montana's goals to the leasing policy decisions soon to be made in the Decker-rney area.

The statement will be distributed prior to the public hearing to be held by nator Metcalf in Billings on April 20 concerning the future of federal coal leasing the Northern Great Plains, as well as before public hearings on the status of the cker-Birney Study. All public comment presented at the hearings will be carefully nsidered before the position of the State of Montana is finalized.

II. PROGRESS TOWARD A COMPLETE ARTICULATION OF GOALS AND OBJECTIVES

Although Montana's goal formulation process is not yet complete, the citizens of his state, acting through their government, have in the last several years taken efinite steps toward articulating land use, socio-economic and environmental objectives elevant to the questions of coal development.

1971 - The Montana Environmental Policy Act requires that all possible environ-ental consequences of any government action be evaluated. Inherent in MEPA are the ntents that adverse environmental impacts be minimized and that all alternatives to a iven development be given thorough consideration before a decision is made.

1972 - The Montana Constitution provides valuable guidelines. Article II, ection 3, states in part: "All persons are born free and have certain inalienable ights. They include the right to a clean and healthful environment . . . ." Under rticle IX, Section 1(1) provides that: "The state and each person shall maintain and mprove a clean and healthful environment in Montana for present and future generations. ection 1(3) further states that: "The legislature shall provide adequate remedies or the protection of the environmental life support system from degradation and rovide adequate remedies to prevent unreasonable depletion and degradation of natural esources."

1973 - Governor Judge requested, and the 1973 Legislature enacted, the Montana Strip Mining and Reclamation Act, the Coal Conservation Act, the Montana Utility Siting Act, and the Montana Water Use Act, which are among the most comprehensive in the nation. The stated objectives of these laws basically reiterate those of the new Constitution, although such policy articulations as ". . . to restore, enhance, and preserve its scenic, historic, archeologic, scientific, cultural, and recreational sites . . ." (Section 2, Montana Strip Mining and Reclamation Act) have been added. The consensus of Montanans, as reflected by those Acts, is clearly: "If coal developme is to proceed, it will proceed only under strict and rigidly enforced controls."

Definitive land use policy and energy policy studies by the Montana Environmental Quality Council were also authorized by the 1973 Legislative Assembly, with findings and recommendations to be reported to the 1975 legislature.

On April 24, 1973, Governor Judge created MEAC, the successor to an Interagency Montana Coal Task Force. In so doing, he said:

> "Our State, from all indications, is on the threshold of massive energy development to ease the much publicized and controversial 'energy crisis,' but inherent in a simplistic solution to one crisis are seeds for another; that of the degradation and destruction of human and natural environmental values and the

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> I believe it unreasonable, inequitable, and contrary to national policy and interest, to temporarily feed a nationwide energy appetite by creating social, environmental, and natural resource problems in one region."

1974 - The most recent, and perhaps most significant, evidence of the views of the Montana public is the overwhelmingly positive response of citizens and legislators to Governor Judge's call for a three-year Water Moratorium, i.e., the suspension of action on the processing of large volume (presumably industrial) water use application in the Yellowstone Basin. Enactment of this law indicates that the people of Montana and our governmental agencies are aware of the potential consequences of immense, energy-related water diversions and are unwilling to accept them without substantial further evaluation. An important feature of the act is that future municipal water needs, flow requirements to maintain the productivity of aquatic life, and projected irrigation needs will all be measured, reserved and accorded preference over the industrial demands which may be submitted in the interim. Regarding water considera-tions, state goals and priorities are rather explicitly stated.

The 1974 Montana Strip Mine Siting Act gave state government the authority to examine and to approve or disapprove the area of a proposed new strip mine prior to any development and large-scale investments.

IV. PRELIMINARY STATEMENTS OF POSITION

Certain of Montana's goals have previously been articulated, as herein summarized. We have related our goals and objectives to the immediate coal leasing options federal agencies have before them, and our preliminary statements of position follow.

A. For at least the initial five years of the EMARS coal leasing program, Montana people and their government would assent to leasing of coal only if its combustion or conversion will take place near the nation's high energy demand areas. Consequently, both the lease terms and the characteristics of the coal deposits chosen for lease should dictate that the coal will be burned or converted at load centers.

This position can be modified only if it can be clearly shown that mine mouth industrialization is necessary to meet state needs.

B. If expanded federal coal leasing is to proceed in Montana, determinations and allocations of acreages and tonnages to be leased should be minimized in recognition of the 1.7 billion tons of federal coal currently under lease in Montana, extensive Indian coal leases, the 32,775 acres of state coal under lease, and the vast reserves of privately owned coal committed to development.

C. If expanded federal coal leasing is to proceed in Montana, all new federal coal leases should reference and require compliance with the Montana Strip Mine Siting Act, Strip Mining and Reclamation Act, Utility Siting Act, Coal Conservation Act, and Water Use Act.

Using the Coal Conservation Act as an example, we note that lease terms can do much to avoid conflict with state law. The terms should address such problems as coal wastage and unnecessary degradation by precluding the restripping of an area. [illegible] higher royalties if only the uppermost seams are mined would be an incentive to [illegible] all seams.

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D. If expanded federal coal leasing is to proceed in Montana, it should proceed exclusively in those areas where all resource values and land uses have been thoroughly inventoried. Only upon the conclusion of such studies can areas of highest conflict be avoided.

This "selective denial" concept is critical to sound resource management and presently can be implemented on a large-scale basis only in the Decker-Birney study area. Leasing of federal coal should not proceed in other regions of Montana until and unless studies of at least equal magnitude have been completed. The historic method of simply responding by leasing in the areas of greatest corporate interest should not be resumed.

E. Bureau of Reclamation or other federal water allocations should not be granted or transferred to corporations within the terms of new coal leases. Such package deals as now being considered by EMARS are unacceptable.

V. DISCUSSION

A. Combining the state mineral and surface estates with those administered by the Forest Service and the Bureau of Land Management, we note the following ownership patterns expressed as a percentage of total acreage.

	Surface Estate	Mineral Estate
Government	31%	93%
Private	69%	7%

These ownership patterns are typical throughout the Fort Union coal region; certainly such patterns are characteristic of most significant Montana coal fields. Accordingly, numerous potential conflicts exist between full or partial utilization of the coal deposits and other public and private uses of the land, water and air resources of the area.

Pursuant to Montana's reclamation and utility siting laws, state agencies are evaluating impacts of strip mining and mine mouth industrialization on a site-by-site basis. Only within the Decker-Birney study area, however, have state and federal officials made appreciable progress in quantifying existing social, economic and environmental values and identifying areas of highest conflicts with strip mining on a comprehensive, large-area basis.

These challenges can be mitigated or possibly resolved only through systematic resource analysis and broad-based multiple use planning with full public involvement. If this process is to succeed anywhere in Montana, it must function within the Decker-Birney planning unit, where the process is most advanced.

B. Although Decker-Birney study officials have done a commendable job in evaluating conflicts between strip mining and all other public and private resource uses, time and manpower limitations have not permitted an evaluation of the even greater potential conflicts involved with mine mouth utilization of the coal. Therefore, if federal coal is to be leased, the characteristics of the coal chosen and the lease terms should restrict development to levels and types whose impacts are understood.

Leasing coal for out-of-state use will allow subsequent evaluation of the con-sequences of mine mouth industrialization in Montana. A detailed Department

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of Natural Resources and Conservation analysis of the effects of proposed Colstrip III and IV will be available within nine months, and the findings will be the most definitive site-specific information in the region. It is unfortunate that federal lease selections will probably occur before that department's studies are completed.

C. Although site-specific data regarding the social and environmental consequences of one power generation complex will soon be available, there has been little definitive work on the cumulative impacts of extensive mine mouth industrialization, and no field data presently exist concerning gasification facilities.

D. The State of Montana acknowledges the conclusions reached by the National Academy of Science's Study Committee on the "Potential for Rehabilitating Lands Mined for Coal in the Western United States."

> "The shortage of water is a major factor in planning for future development of coal reserves in the American West. Although we conclude that enough water is available for mining and rehabilitation at most sites, not enough water exists for large-scale conversion of coal to other energy forms . . .. The potential environmental and social impacts of the use of this water for large-scale energy conversion projects would exceed by far the anticipated impact of mining alone. We recommend that alternative locations be considered for energy conversion facilities. (Emphasis added.) 1/

E. The strippable coal deposits in the Decker-Birney area vary in such character-istics as seam thickness, BTU per pound, sulfur content, ash content and fusion temperature. Although the market place and economic considerations should not be the primary factor in selecting lands for lease, leasing of the highest BTU and lowest sulfur coal can do much to assure that the coal will best address short-term national needs.

F. New mine mouth power generation for which no commitments have been made would not be on line until about 1980, and gasification plants are not likely to be commerciall operative until later in the 1980's. Consequently, the Federal Energy Office has placed a high priority on the conversion of existing oil and natural gas fired power plants to coal. Many of those conversions require only six months to a year, much less time than it takes to open a new strip mine.

If the relatively low-sulfur coal of Montana is mined, shipped and then utilized following the conversion of those existing plants, perhaps the $SO_2$2 emission standards in the centers of industrialization can be maintained.

G. Economics should not be the sole factor in determining whether coal is converte in Montana or shipped out. It was concluded however, in the Southwest Energy Study that:

1/ The National Academy of Sciences/National Academy of Engineering, Rehabilitation Potential of Western Coal Lands, Report to the Energy Policy Project of the Ford Foundation, 1973, pp. 10-11.

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"Negl[illegible]ng possible environmental effects, comparisons between coal-fired generation near the mine and near the load center appear to show little difference in economics." 2/

8. Should the federal government make industrial water available to corporate lessees at the time coal is leased, Montana government and the people it represents will have diminished influence upon the future of our state and our way of life. Such actions would make a travesty of local planning efforts presently underway.

VI. COMMENT

The State of Montana wishes to reiterate its desire to help meet the essential energy needs of our nation. However, we believe a careful distinction must be drawn between "energy needs" and "energy demands," and we do not believe that one region should be asked to bear a disproportionate share of the social and environmental costs of meeting nationwide needs.

2/ U.S. Department of the Interior, Southwest Energy Study, An Evaluation of Coal-Fired Electric Power Generation in the Southwest, April 1972, p. S-5.

DOLPH BRISCOE
GOVERNOR

OFFICE OF THE GOVERNOR
DIVISION OF PLANNING COORDINATION

JAMES M. ROSE
DIRECTOR

September 10, 1974

Mr. Lowell J. Udy
Director
Eastern States Office
Bureau of Land Management (723)
18th and C Street, N.W.
Washington, D. C. 20240

Dear Mr. Udy:

The Draft Environmental Impact Statement (EIS) titled "Proposed Federal Coal Leasing Program," submitted by the Bureau of Land Management, has been reviewed by the Governor's Division of Planning Coordination and by other State agencies.

Review participants have submitted the following comments and recommendations that warrant your careful consideration:

1. The Bureau of Economic Geology (BEG) indicated that the figures from the Bureau of Land Management on Texas lignite reserves differ significantly from the calculations made by BEG, particularly with regard to the reserves that are potentially available through surface mining.

2. Extensive comments and a Staff Analysis Report were submitted by the Texas Water Rights Commission (TWRC). Included in these comments were specific recommendations that the referenced document should contain (1) quantitative cost-benefit data and analysis, (2) an evaluation of the coincidence of coal provinces with aquifers, agricultural or forestry provinces and the cumulative geologic and physiographic impacts, (3) the salient portions of the Atomic Energy Commission's position on the relationship of the coal leasing program to "Project Independence," (4) more complete analysis of the long-term impacts of developing all natural resources currently in high demand, and (5) a discussion of the evaluations, findings and technical guidelines from the Environmental Protection Agency regarding reclamation of strip-mined lands. Due to the absence of a detailed cost-benefit analysis, the TWRC has indicated that the EIS does not appear to be in conformance with the provisions of the National Environmental Policy Act of 1969. A more detailed discussion of the above points is included in the Staff Analysis Report.

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Phone 512/475-2427 Offices Located in Sam Houston State Office Building

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Mr. Lowell J. Udy
Page 2

3. The Texas Water Development Board (TWDB) recommended that more controls need to be placed on auger mining as a method of coal recovery, as this method frequently leads to unstable slope conditions in the area. In addition, the TWDB indicated that the EIS should have addressed the issues of mine-mouth electric generation coal liquification, coal beneficiation, and in-situ processes, and the respective environmental impacts of these actions.

4. Comments from the Texas Parks and Wildlife Department indicated that the EIS presents an adequate evaluation of the environmental impacts, but recommended several species which occur in the Gulf Coal Province be added to the endangered species list in Appendix C.

5. The Texas Water Quality Board indicated that within Texas, mine waste is classified as an industrial solid waste, and therefore, subject to the provisions of the Solid Waste Disposal Act.

6. The Texas Historical Commission noted that most of the areas being proposed for possible surface mining would have to be subjected to a thorough archeological survey to locate, record and appraise the cultural resources prior to actual operations. Selected sites would be preserved by some acceptable method of resource reclamation.

7. It was noted by the Texas Department of Agriculture (TDA) that the EIS should have included direct references to the numerous publications from the U. S. Department of Agriculture pertaining to soil conservation and restoration. The TDA also indicated that a shortfall of all fuels, rather than simply a shortage of petroleum, will contribute to pressures to develop and use coal resources. Uses of solar, geothermal and solid wastes as other fuel sources should also be thoroughly discussed in the EIS.

This Division concurs with the assessment made by the Texas Water Rights Commission, that the EIS does not appear to conform to the provisions of the National Environmental Policy Act of 1969. Specifically, we recommend that in subsequent publications greater emphasis be placed on the cumulative impacts of wholesale mining on the major freshwater aquifers, and agriculture and forest regions with the State. We would also add that this letter not be interpreted as the formal and final State position, but is intended as tentative comment, subject to the completion of studies by the Governor's Energy Advisory Council.

Enclosed for your consideration are the comments submitted by the review participants. Since extensive time was required in the preparation of these

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Mr. Lowell J. Udy
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comments, we recommend that they be reviewed in their entirety. If we can be of further assistance, please let us know.

Sincerely,

James M. Rose
JAMES M. ROSE
Director

JMR/wsb
Enclosures
cc: Dr. W. L. Fisher, Bureau of Economic Geology
Mr. A. E. Richardson, Texas Water Rights Commission
Mr. Harry P. Burleigh, Texas Water Development Board
Mr. Clayton T. Garrison, Texas Parks and Wildlife Department
Mr. Hugh C. Yantis, Jr., Texas Water Quality Board
Mr. Truett Latimer, Texas Historical Commission
The Honorable John C. White, Texas Department of Agriculture
Mr. Glenn J. Cook, Brazos Valley Development Council

MOND R. RIIMMONDS
Coachella Valley County Water District

RAYMOND E. BADGER
San Diego County Water Authority

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The Metropolitan Water District of Southern California

HAROLD F. PELLEGRIN
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VIRGIL L. JONES
Palo Verde Irrigation District

ROBERT V. PHILLIPS
Department of Water and Power, City of Los Angeles

CARL C. SEVINS
Imperial Irrigation District

MYRON B. HOLBURT
Chief Engineer

STATE OF CALIFORNIA

Colorado River Board of California

107 SOUTH BROADWAY, ROOM 8103
LOS ANGELES, CALIFORNIA 90012

July 2, 1974

Mr. Curt Barklund, Director
Bureau of Land Management
Department of the Interior
Washington, D. C. 20240

Dear Mr. Berklund:

We have reviewed the "Draft Environmental Impact Statement, Proposed Federal Coal Leasing Program", DES 74-53, Bureau of Land Management, Department of the Interior and have the following comments:

The interests and concerns of the Colorado River Board of California in the proposed Federal coal leasing program are identified primarily with the water quality aspects of the program in the Colorado River Basin. Accordingly, we are interested in seeing that all coal leases on Federal or other lands contain adequate provisions to prevent further degradation of the quality of the water in the Colorado River, especially the water delivered to California's Colorado River water users.

We believe as a matter of policy that an adequate water quality monitoring program should be established prior to the granting of any leases, so that there will be sufficient background water quality data, from which to be able to ascertain changes brought about by the development of each specific land area.

To the maximum extent possible, there should be no return of dissolved solids to the river system, and that adequate provisions thereon should be incorporated in the lease documents.

Each environmental impact statement for a specific land area in the Colorado River Basin should give the quantitative effect on water quality parameters from the consumptive use

Mr. C. Berklund
July 2, 1974
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of water, and the addition of dissolved minerals to the salt load of the Colorado River at Hoover Dam and at Imperial Dam. Also, the economic detriments, in dollars per year, that Lower Basin Colorado River water users would experience should be stated.

Thank you for the opportunity to comment on the environmental impact statement for the proposed Federal coal leasing program, and we look forward to continued cooperation with your office.

We would appreciate being placed upon the mailing list of those organizations to receive copies of Draft and Final Environmental Impact Statements in connection with the leasing of specific land areas in the Colorado River Basin for the exploitation of coal or other mineral resources.

Sincerely yours,

Myron B. Holburt
Chief Engineer

Environmental Impact Assessment Project

1717 Massachusetts Avenue, N.W., Suite 300, Washington D.C. 20036

August 30, 1974

Malcolm F. Baldwin, Director
Telephone (202) 462-5700

Hon. Rogers C. B. Morton
Secretary of the Interior
Department of Interior
Washington, D.C. 20240

Dear Secretary Morton:

I am pleased to present to you a comprehensive review of the Draft Environmental Impact Statement on the Federal Coal Leasing Program, prepared by a team of 27 scientists and other experts under the auspices of The Institute of Ecology. This review is part of a larger effort by TIE to assist federal agencies in improving the NEPA process through review of individual environmental impact statements and examination of federal agency guidelines.

The review of the Proposed Federal Coal Leasing Program expresses severe criticism of the proposed program in its present form. The inadequacies we found in the EIS are so pervasive, perhaps due to the foreshortened time period in which the document was prepared, that the team felt compelled to recommend that a wholly new draft EIS be prepared. Basic policy questions, alternative courses of action and large quantities of information about coal and coal development impacts need to be considered by the Department and the public in a systematic, objective and open fashion. A new draft would enable both the Department and the public to evaluate the proposed program in light of new and forthcoming studies by other federal agencies, state governments and research groups. The EIS can be an ideal vehicle for such analysis; it is regrettable that this draft EIS falls so far short of its potential.

We hope this review proves useful to the Department of Interior's future deliberations about federal coal management policies and we look forward to receiving the Department's response to our review.

Sincerely,

Katherine Fletcher

Katherine Fletcher
Editor

encl.

A project of The Institute of Ecology

SUMMARY AND RECOMMENDATIONS

I. SUMMARY

A. Section 1: Introduction

1. In the context of a well-reasoned moratorium on coal leasing, it was anticipated that this EIS would deal extensively with past leasing, ways in which existing leases are and can be administered, and with the many options open for future federal coal management.

2. Though this EIS is labeled "programmatic," neither the federal coal program is examined nor are alternative future policies delineated.

B. Section 3: The Department's "Proposal"

1. No "program" is defined, though there are repeated implications in the EIS that some vague notion of renewed federal coal leasing is being considered.

2. EMARS (Energy Minerals Allocation Recommendation System) is, paradoxically, not described in sufficient detail to allow review, though it appears to be an improved system for implementing coal leasing.

3. The EIS contains simplifying assumptions which render the analysis of questionable usefulness, among them: (a) that coal conversion facilities need not be analyzed; (b) that Indian lands need not be considered; (c) that eastern coal need not be compared or considered along with federal coal.

4. The EIS is fundamentally inadequate; the basic structure for an EIS is missing - no proposal, no options, no explanation and justification of assumptions.

C. Section 4: Putting Federal Coal Leasing in Perspective

1. The EIS fails to demonstrate the need for renewed federal coal leasing, to determine the potential impacts and to formulate and analyze mitigating measures.

2. The EIS shows that vast quantities of federal coal are already under lease, but neglects to consider ways to administer rationally those leases, and does not draw the obvious conclusion that more coal leases are not needed.

3. The present leases of many billions of tons of coal (approximately 22 billion tons) are not examined for minability or environmental factors, nor are the pending preference right lease applications considered in any detail.

4. There is enough federal coal under lease to last 118 years at the rate of production predicted for the year 2000.

5. The federal government has failed to assure fair market value return for federal coal leases - the government has been practically giving away federal coal lands since 1920.

6. Speculators have been holding federal leases at minimal cost, leases never expire, and have been seldom adjusted to account for changing times.

7. The EIS fails to discuss any methods of preventing speculation.

8. Most federal leases have failed to incorporate environmental protection.

9. Calculating coal reserves on the basis of heat (Btu) content shows that 72% of the nation's coal is found in the East.

10. The EIS demonstrates no understanding of the national coal picture: the relative advantages of moving the industry out of the East to the West, of strip vs. deep mining, and of eastern vs. western coal are not discussed.

11. The major reasons the coal industry is moving West appear to be: (a) the ability to secure large blocks of resources and land; (b) in some cases, Clean Air regulations; (c) thick coal seams; (d) absence of the United Mine Workers; (e) weak state laws controlling development.

12. The low heat content of most federal and western coals means that EPA sulfur standards frequently cannot be met without stack gas scrubbers - hence the "low sulfur" rationale for moving west does not hold up under scrutiny. A discussion of this problem in a pre-draft of the EIS was inexplicably deleted in the current version.

13. High moisture and ash content of western coals also detract from the economics of their utilization, cause problems of substitutability in existing boilers, and adversely affect electrostatic precipitator function.

14. Truly low sulfur coal exists in large quantities in the eastern United States, primarily in West Virginia, eastern Kentucky and western Virginia. This coal is higher in quality than western coal, and also exists near both load centers and labor force. The EIS totally ignores non-federal coal.

15. The EIS also indicates that deep mining is not, or should not, be an important factor in coal supply. Yet lead times for opening deep mines in the East are actually shorter than for strip mines in the West, and safety problems are soluble.

16. The EIS accepts, without substantiation, the companies' "conventional wisdom" concerning strip mining and western coal. Yet

the public interest is not served by this unquestioning and unanalytical approach.

D. Section 5: Inadequacies in the Data Base of the EIS

1. The Department of Interior does not know how much coal it actually controls, and the analysis in the EIS is misleading for two reasons: (1) the data used are unreliable; and (2) the data are presented in a biased fashion.

2. The Department of Interior does not know the amount of minable acreage it controls; though the EIS seems to propose further leasing, no inventory even of existing leases has been made.

3. There is considerable discrepancy among the EIS data concerning leased coal. Updated estimates of federal coal committed by lease and preference right lease applications (PRLA's) are more than twice the estimates used in the EIS.

4. The EIS's contention that leased and PRLA coal are overstated, in that much of it may be unminable, is ridiculous and unsubstantiated. The Department has not determined the minability of the reserves it has leased, but our preliminary analysis shows that more than 93% of the acreage covered by federal lease is in minable blocks.

5. The statement in the EIS that "there is probably not enough federal coal to meet the nation's needs without additional federal leasing [.]" (I-202) is not defensible.

6. The EIS estimate of federal strippable reserves in the West - 15 billion tons - is absurd. Current estimates for three states alone amount to 54.6 billion tons.

7. Western federal coal is generally of very poor quality. Because of low heat content, 55% of western coal reserves cannot be labeled "low sulfur." Eastern low sulfur coal potential is completely misrepresented in the EIS.

8. The EIS, by considering only federal coal, presents an inaccurate picture of the national coal situation. Vast quantities of non-federal coal reserves are committed by lease in the Northern Plains, thereby decreasing significantly the importance of federal coal.

9. In addition to sweeping deficiencies in basic data, the EIS contains many numerical errors.

10. Deficiencies in the data used in the EIS point both to the use of outdated and biased information and to the true lack of basic data. The EIS has failed to make any systematic analysis of what the Department knows, and what it needs to learn.

E. Section 6: Legal Framework of the Federal Coal Leasing Program

1. The EIS does not adequately discuss how existing leases and preference right lease applications are, will be and can be administered to provide for environmental protection. Apparently the Department does not intend to comply with the June 30, 1972 Secretarial order on this subject.

2. The legal and policy questions concerning adjustments of existing leases - whether adjustments can take place prior to the renewal period, whether adjustments will be made, how the adjustment process will operate - are not examined in the EIS.

3. There is no discussion to indicate whether new regulations will apply to existing leases and preference right lease applications.

4. The EIS inexplicably states that the Department assumes that all existing leases will produce coal, and implies that no environmental controls will be exerted over these leases. In addition, there is no discussion of diligence requirements, from either a legal or environmental standpoint.

5. The legal and policy questions concerning preference right lease applications are left completely unanswered in the EIS.

6. It is not clear from the EIS whether the issuance of prospecting permits - one of the most serious abuses in past leasing - will still be allowed in a new leasing system. Indeed, it is indicated that prospecting permits will be issued when "appropriate." (I-148)

7. The EIS contains no lucid analysis of the proper terms and stipulations for new leases. Bland general assurances are coupled with many inconsistencies and ambiguities in specific discussions.

8. The relationship of state to federal laws and regulations is left unclear. Apparently, a weak state law might be applicable, even where federal regulations are more stringent.

9. The EIS fails to deal with the serious problems arising from privately held surface lands over federal coal.

10. The EIS only peripherally considers whether existing monitoring and inspection requirements and techniques are adequate; overwhelming evidence indicates they are not.

11. The EIS fails to consider the fact that pending federal legislation concerning strip mine control may require complete revision of federal regulations.

12. The EIS does not make clear the Department's intentions with respect to the role of NEPA in future coal-related decisions and actions.

F. Section 7: Alternatives

1. In the absence of a definition either of a federal coal leasing "program," or of options for federal coal management, it is impossible to determine to what proposals "alternatives" are being considered.

2. The consideration of energy alternatives is not related by the authors to decisions concerning coal policy; much of the discussion consists only of "boilerplate" descriptions of various energy sources.

3. Major energy conservation potentials are dismissed without adequate analysis.

4. Alternative federal coal management schemes are not analyzed.

5. The conclusion that the alternative of no further federal leasing is untenable is totally unsubstantiated.

6. The authors have little concept of the range of available alternatives, stating that the major choice to make is between "orderly" and "unregulated" leasing.

G. Section 8: Environmental Impacts: A Critique by Disciplines

1. Hydrology/Geology: A mechanism to evaluate costs and benefits of coal development is discussed.

2. Water Supply: The EIS does not analyze perhaps the most difficult and complex problem associated with federal coal development - water.

3. Atmospheric Effects: Severe regional impacts such as massive air quality degradation and climatic changes are the likely result of large-scale western coal development.

4. Biota: The EIS demonstrates no understanding of ecosystem function, and harbors important misconceptions concerning flora and fauna.

5. Trace Elements: Little is known about the impacts of trace element contamination from coal mining and combustion; there is cause for serious concern, and desperate need for more information.

6. Social and Cultural Impacts: The EIS contains essentially no socio-cultural impact analysis. Yet this is one of the most significant impact parameters, because of both anticipated "booms" and "busts" due to federal coal development.

7. Aesthetics: The EIS has failed to grasp, describe or integrate even the most basic aspects of aesthetic considerations.

8. Archaeology/History/Paleontology: With respect to all three of these topics, much further field investigation must precede major decisions concerning coal development. Existing laws are very protective in language, but in practice can rarely be enforced.

9. Economics: The EIS neglects basic economic factors, and fails to utilize benefit-cost analysis, or any comparable objective analytical tool. In addition, the notion that EMARS will be a finely tuned instrument in the energy supply/demand situation is totally unsubstantiated.

10. Reclamation of Mined Land: The potential success of reclamation of mined land in the West is very uncertain at best. The EIS presents no well-organized, comprehensive discussion of this topic, even though it has attracted significant public attention and concern. It appears from this EIS that adequate reclamation requirements and enforcement will not occur on existing leases, let alone on any future lease, even if reclamation proves possible.

H. Section 9: The EIS and Federal Coal in Alaska

1. The EIS did not provide sufficient information on Alaska to allow meaningful review.

I. Section 10: Rational Planning: Involving the Public

1. The EIS fails to accomplish "full disclosure" - the necessary prerequisite to public participation in decision-making. The Department, totally apart from the NEPA process, has developed much of the information critical to formulating federal coal policy.

2. It is not clear how Departmental coal-related decision-making relates to Project Independence. The Department has developed a report for the Federal Energy Administration in which coal development strategies are analyzed, yet this information is apparently not part of the NEPA analysis.

3. EMARS appears to be an improvement over past leasing practices, but major policy decisions precede EMARS implementation. There is a large gap between NEPA analysis at the vague level of this EIS and the anticipated site-specific analyses under EMARS.

4. Neither the Department nor the federal government in general has seriously attempted to involve the public in the formulation of coal management policies.

II. RECOMMENDATIONS

A. This draft EIS should not be revised; a new draft is needed. The new draft:

1. Should address the important policy questions at hand, such as:

a. How should existing coal leases and preference right lease applications be managed?

b. Is further federal coal leasing either necessary or desirable?

c. When, how, where and under what conditions should further federal coal leasing take place?

d. How does or should federal coal fit into broader energy policies?

2. Should include and consider basic information concerning coal and environmental impacts.

3. Should attempt to formulate and compare alternative coal management policies, rather than remaining confined to a consideration of new leases.

4. Should utilize cost-benefit analysis or some comparable systematic and objective mechanism for responsible decision-making.

B. The present moratorium on federal coal leasing should be continued until:

1. The need for further leasing is established.

2. Strong federal laws exist regulating surface mining.

3. Existing leases and preference right lease applications come under sound environmental and management practices.

4. Mineral leasing laws are revised to ensure environmental quality and protection of the public trust.

5. Project Independence has been fully debated and evaluated by the government and the public.

6. Basic information on coal and coal development impacts is both understood and evaluated.

C. Immediate attention should be focused on the urgent problems of existing leases and preference right lease applications, including:

1. Analysis of legal mechanisms for exerting sound controls.

2. Inventory of all coal and coal lands under lease and PRLA.

3. Determination of leases and PRLA's where development would be environmentally unacceptable.

4. Consideration of diligence requirements and prevention of speculative practices.

THE SOCIETY OF VERTEBRATE PALEONTOLOGY

Section of Vertebrate Fossils
Carnegie Museum of Natural History
Pittsburgh, Pa. 15213

June 26, 1974

Curt Berklund, Director
Bureau of Land Management (723)
18th & C Streets, NW
Washington, D. C. 20240

Dear Mr. Berklund:

We in the Society of Vertebrate Paleontology, the professional society that represents vertebrate paleontologists in this country, are deeply concerned with the subject of the Federal Coal Leasing Program as outlined in DES-74, the Draft Environmental Impact Statement on the Proposed Federal Coal Leasing Program. We are, of course, concerned that many irreplaceable fossils will be destroyed unless adequate salvage provisions are included in any leasing agreements between the Federal Government and mining companies. Accordingly, this letter includes our comments on the draft statement with the request that these matters be considered in preparation of the final environmental statement.

Basically we are favorably impressed with parts of DES-74, especially with the clear statement on pages IV-57-58 dealing with the value and importance of vertebrate fossils and the proposed method for salvage work to save them from destruction. The program outlined in that section is well thought out, and we recommend that it be implemented with some additions. The program should include: 1) paleontological survey prior to excavation to determine the paleontological potential of an area to be mined, first by a literature survey and second by inspection of the site, of drill cores, and any other information available at the site. 2) If the survey reveals significant fossils in the overburden, salvage work should be done by trained field paleontologists, under the direction of the USGS.(Survey paleontologists and those from the Smithsonian and universities and museums could work in the salvage operation.); 3) As mining progresses, checks should be made by trained paleontologists to determine whether fossils are being uncovered, and if fossils are found, their excavation should be undertaken as above. 4) Since cooperation of the miners and mining supervisors is of the greatest importance, a program to inform them on the importance and appearance of fossils should be undertaken at each site. 5) Any fossils uncovered should be deposited in scientific institutions and available for study by properly qualified scientists.

Appendix G of DES-74 shows that several existing leases set a precedent of sorts for protection of vertebrate fossils. (Example (a) 17. "When American antiquities or other objects of historic or scientific interest, including, ... vertebrate fossils. . . . are discovered . . . . the item(s) . . . . will be left intact. . . ."; Example (d) 6. q). Although these clauses are not as complete as the program outlined above, at least they do emphasize the value of preserving this sort of vital scientific information.

Society of Vertebrate Paleontology

We must point out that the Antiquities Act of 1906, providing fines up to $500 and 90 days in jail for persons damaging fossils, cannot be relied upon to control destruction of fossils by proposed mining operations. Rather than these fines, which are, to be realistic, meaningless to large coal companies, we strongly recommend the positive approach of saving the fossils, a priceless scientific record, and, if possible, gaining the cooperation and support of mining companies in this essential endeavor. After all, without the basic information gotten from fossils, prospecting for coal, oil, and many other minerals would have been much more difficult than it is with good stratigraphic evidence!

A practical example of the sort of program we outlined briefly above has been undertaken by the Museum of Northern Arizona in an area to be disturbed by the Wesco coal gasification plant near Burnham, New Mexico. We feel very encouraged that this project has been funded, and regard it as a desirable prototype for further paleontological salvage operations in coal bearing areas.

We are greatly encouraged by the statement of Mr. Dwight Patton--1972(723-- that, "It is the desire of the Bureau of Land Management to provide the maximum protection for and recovery of fossils of merit." Now we urge you to include this protection of valuable national and international scientific treasures in the final EIS.

Should you have questions or require further information, please contact me or Dr. David Whistler, Los Angeles County Museum of Natural History, 900 Exposition Blvd., Los Angeles, California 90007.

Sincerely,

My R Daw

Mary R. Dawson
President

Chamber of Commerce of the United States

HUMAN AND COMMUNITY RESOURCES DEVELOPMENT GROUP
202 659 6170
1615 H STREET N W
WASHINGTON D C 20006

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August 19, 1974

Mr. Curt Berklund
Director
Bureau of Land Management
18th and C Streets, N. W.
Washington, D. C. 20240

Dear Mr. Berklund:

We have reviewed the draft Environmental Impact Statement (DES 74-53) for the proposed Federal Coal Leasing Program, and we respectfully submit the following comments:

First, we question the timing of this draft statement, particularly insofar as the scheduling of review comments and publication of the final NEPA statement is concerned. At the time this schedule was prepared, no one could have foreseen that basic surface mining control legislation would be on the verge of passage by Congress. Yet, the passage of such legislation will affect much of the coal leasing program outlined in the draft statement. For this reason, we feel the preparation of a new statement -- reflecting the changes that will probably be made in federal mining law this year -- should be undertaken with these new legal strictures in mind.

Second, we feel that EMARS allocation system is an impracticable attempt to fine-tune the complicated relationship between the actual level of coal mined and the actual demand for coal in the fuel minerals marketplace. Such an undertaking is fraught with economic peril. It requires federal policy makers to estimate the amount of coal that might be needed at some future point, even though a plethora of variables might intervene to make these projections invalid between the time that the coal is committed and the time that it is actually used. No official could have foreseen the effect of last winter's oil embargo on coal demand, nor could he have foreseen the impact of auto emission devices or stationary effluent controls on the consumption of petroleum products. Yet, each of these events affected the demand for coal. The free marketplace is not perfect. There are periodic surpluses and shortages of many commodities. However, the market's track-record in meeting product demands over the years has been good enough to suggest that a bureaucratic attempt to balance consumption and demand is both unnecessary and unwise.

Third, we question the practical need and the legal requirement for an Environmental Impact Statement for each and every lease. The impact statement for the overall leasing program and an additional statement for a program of environmental safeguards vis a via surface mining practices on public lands should be enough to protect environmental values. The requirement set out in DES 74-53 would be duplicative and time consuming.

Mr. Curt Berklund
August 19, 1974
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Fourth, we object to the suggestion that a federal coal development program might realistically replace the free market system that has heretofore characterized the coal industry. While this was put forward only as a possible alternative, we hope this proposal isn't a hint of the type of thinking going on within the federal natural resource agencies. On the whole, the private sector has done an outstanding job of extracting, processing and distributing mineral resources. There's no available evidence that the federal government could improve upon this performance.

Finally, we wonder if an allocation scheme based upon governmentally determined need would entail government control over the end uses of coal. Would the mining company be regulated as to whom it sells coal and for what price?

In closing, we would reiterate our suggestion that this undertaking be held in abeyance pending congressional disposition and departmental implementation of surface mining legislation.

Sincerely,

David Luken

David Luken
Associate Director
Natural Resources, Environment
and Energy Section

NATIONAL COAL ASSOCIATION

Coal Building 1130 Seventeenth Street, Northwest Washington, D. C. 20036 (202) 628-4322

August 28, 1974

Mr. Curt Berklund
Director
Bureau of Land Management
18th and C Streets, N.W.
Washington, D. C.

Dear Mr. Berklund:

Interested parties were invited to submit their comments on the Draft Environmental Impact Statement (EIS) concerning the proposed Federal Coal Leasing Program. After review of this document, the National Coal Association has the following comments which are respectfully submitted for your consideration.

The EIS is extremely general in many of the essential aspects and details of the proposed Federal Coal Leasing Program are not set out with any degree of specificity. As a result, it is extremely difficult to completely understand precisely what EMARS (Energy Minerals Allocation Recommendation System) is or how it will function, or its relationship to the Bureau of Land Management's Land Use Planning System.

However, in order to respond and be constructive, we, of necessity, have been forced to deal with the coal leasing system in a general way.

Serving the Bituminous Coal Industry Since [illegible]

NATIONAL COAL ASSOCIATION Page 2

However, the particulars of the program are extremely critical to the coal industry and the National Coal Association respectfully reserves the right to comment on them when the department elaborates on the program. Presumably, this will be done in the proposed final EIS.

The National Coal Association recognizes that the Department of the Interior must have a clear-cut and consistent policy for the leasing of federal coal reserves on lands administered by the Bureau of Land Management. We also recognize that in the development of this policy, the department must take account of the resource potential, environmental factors, costs and other considerations affecting the national welfare of the United States, both now and in the future.

Of course, an overriding concern today must be the attainment of national energy self-sufficiency, which has become a question of the most urgent national priority.

It is against this background that we wish to address the Environmental Impact Statement on the proposed Federal Coal Leasing Program.

First, we support and urgently request the renewal of coal leasing on federal lands.

Such a renewal is vital for three fundamental reasons.

1. The growing demand for energy requires the early and orderly development of America's vast coal resource. Coal

NATIONAL COAL ASSOCIATION Page 3

production which is now approximately 635 million tons annually, should increase to between 1.2 and 1.5 billion tons by 1985. In order to achieve this production, we must begin now to turn our coal reserves into a commercially available energy resource. Since federal coal is such an important part of the total available coal reserve, its early development is a prime national importance.

2. The long lead times necessary for both mine development and for the construction of conversion facilities requires early assurance of coal availability. Even now, too much time has been lost to potential consumers of federal coal. Utility stations needed in the 1980-1985 period should now be under design, and the coal necessary to fuel them should already be committed. Unfortunately, the abrupt halt of the Federal Leasing Program three years ago has raised uncertainties about future federal actions and thus about the fuel availability so necessary for the growing utility sector as well as for coal gasification--an area in which the department has a current priority. Since demand levels seem to grow, even in the face of conservation measures, expeditious action on the supply side seems to be indicated if a future energy crisis is to be averted.

3. The new contingencies imposed by the mandate for national self-sufficiency add to the intensity of the need for renewed federal coal leasing. If, in fact, America is ever to

NATIONAL COAL ASSOCIATION Page 4

become even reasonably self-sufficient, the vast reserves of federal coal must be made available for production--and now.

At the present time, in the executive branch and among many influential members of the Congress, there is active support for Project Independence. To us, that support must logically include corresponding active encouragement of an expedited and expansive federal coal leasing policy.

Second, we do not believe that the Environmental Impact Statement focuses on the positive results which will come from an expedited and expanded coal leasing program. We believe that such emphasis is extremely important because it places in proper perspective the relative costs and benefits of the development of the vast national wealth inherent in federal coal reserves.

For example, the potential benefits from federal coal development are virtually ignored and thus, by default, at least only the costs are fully emphasized.

Historically, America has grown because of the development of our indigenous resources. Such growth has meant not only a higher standard of living for all of our citizens, but also has made possible our military security and all of the social welfare programs which now characterize our society.

It is evident that our future progress as a nation rests in the ultimate sense upon our further ability to utilize our

vast remaining coal resources consistent with other national goals including environmental protection. Within this growth structure will come the jobs, income and capital investment of an America which has both a dynamic economy and the ability to pursue its other goals and which will put America back on the road to a degree of self-sufficiency characteristic of our past. Therefore, we view growth as a positive and desirable goal and one which should attract cooperative efforts of all sectors of the society.

It is, therefore, extremely disconcerting to see the tone of the Environmental Impact Statement on Federal Coal Leasing. Throughout both volumes, one conclusion is inescapable:

> The authors view coal development as essentially an unavoidable evil, tolerable only because it seems to be necessary.

We reject this logic and the image of coal development it portrays. In many ways, coal is the principal value of federal lands in the West and coal development, even if it is a one-time use, would be the best possible way to develop federal land. The fact that coal lands can be reclaimed to a state of value, at least as great as the original, makes federal coal America's single most valuable resource. Indeed, if assessed at present value, the total worth of U.S. owned coal reserves in eight western states alone amounts to more

than $500 billion. The economic potential alone inherent in such development justifies the most positive response from government and the public alike.

It is, therefore, with substantial justification that we suggest that the tone of the Environmental Impact Statement should be a positive one. It should outline those costs involved in the development of federal coal lands, but should balance those costs with the very real value to the nation and its citizens which will come with such development. Such value can be measured not only in terms of dollars paid into the federal treasury from royalties, etc., but also in terms of increased citizen well-being and the very real potential for an energy self-sufficient America.

In the final analysis, however, any examination of the value of the leasing of federal coal must inevitably rest upon an appraisal of the future energy demands of the United States and the role of coal in meeting those demands. It is unfortunate that the EIS was particularly deficient in setting forth the role that coal must play and the rationale behind such an expanded role for the coal industry. Instead, the statement contented itself with assuming the growth of coal simply because of the unavailability of oil and with a somewhat peripheral treatment of the increasing need for a primary energy source for an America which simply must have both relatively rapid energy growth and the basic supply being developed from indigenous coal resources.

A rigorous analysis of future projections of energy supply/demand equilibrium points would have led inescapably to the conclusion that expanded coal production--on a scale never before matched in this century--is vital to the future of the American economy and those political and social institutions which rest upon the viability of that economy. Once reached, such a conclusion would inevitably lead to a concomitant conclusion that the total coal mix of the future must contain within it a significant component of federal coal on the supply side if, in fact, America can continue to make progress in both the economic and social fields and if the military security of the U.S. is to be maintained in the decade of the 80's and 90's.

In assuming the unlimited availability of oil, the EIS ignored the fact that in the areas served by western federal coal, important residual oil is simply not a viable option. Such oil cannot realistically be transported to these areas even if it were available on the world market. Moreover, additional supplies of domestic oil will tend to gravitate to markets where petroleum has a unique application and where fuel substitution is impossible, for example, transportation and existing residential space heating.

In addition, the EIS tended to grossly underestimate the rehabilitation potential of lands overlying western federal coal. A comprehensive study on this subject done by the

National Academy of Engineering indicated a high degree of certainty of rehabilitation for much of western coal lands. This does not suggest that the coal industry takes rehabilitation efforts for granted but only that such rehabilitation is probable and that leasing programs and mining operations can proceed at an accelerated basis upon the near certainty that rehabilitation will, in fact, take place. This is in direct opposition to at least the tone of the EIS which suggests strongly that lack of rehabilitation is part of the cost to be borne if western coal lands are to be developed. We do not believe this to be a fact and we suggest that the American public should not be led to the erroneous conclusion that irreparably or irretrievably damaged landscape is an inevitable part of coal development. (This will be elaborated on further in our comments with reference to the misleading statements in the EIS.)

Third, there is a clear-cut need for a federal leasing policy geared to the emerging demands on the coal production capacity of the United States.

The National Coal Association recognizes the need for a federal coal leasing policy. The value of federal coal, both the costs and the benefits incident to its extraction, and its emerging importance to the national welfare make the formulation and implementation of a leasing policy an urgent national priority.

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In our opinion such a policy should be directed toward several objectives.

One, it should make possible the early resumption of the Federal Coal Leasing Program, including the resumption of both prospecting permits and preference right leases.

Second, it should establish guidelines which will make federal coal available on the basis of non-discrimination to all potential bidders.

Third, it should be directed toward those economic entities who will diligently develop their reserves and discourage the holding of leases purely for speculation.

Fourth, it should insure the availability of sufficient federal coal to meet market demands for such coal, in a manner and at a time that is consistent with the diligent and rational development of the reserve involved.

In the evolution of federal policy, the voice of energy--both producer and consumer--simply must be heard. It is to industry that the nation must look for the job of bringing these resources into commercial being; thus industry rightfully can ask for an input into the evolving policy surrounding federal leasing.

As stated above, we do favor an effective federal coal leasing policy. We do not believe that EMARS, as it is now constituted, meets the criteria for that policy in the following respects.

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First, the EMARS program appears to incorporate a degree of detailed planning that far exceeds the ability of the federal government, or even the private sector, to forecast future events.

In the EIS, the authors tend to determine federal leasing through a series of detailed plans which will determine at any given point in time the amount of federal coal which will be leased. In our opinion, this allocation system is contrary not only to the concept of free enterprise but more importantly, perhaps, to the welfare of the people of the United States.

We do not see any ability existing on the part of the federal government which would permit any agency of the government to forecast future events with the degree of precision necessary to insure a proper equilibrium in the coal marketplace. Nor do we believe that detailed planning of the needs for coal-derived energy on a regional basis can be done without requiring planning of the nation's entire energy mix. Such planning is contrary to both our concept of how the market system should work and more importantly contrary to what the experience of government planning in the past has taught us as to the validity of such planning.

Since energy is a very basic commodity of our nation, relatively minor differences in the plan vs. the actual event could well result in major disruptions of the nation's coal industry and, very possibly, the entire economy which is so heavily dependent upon energy.

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At issue is simply the ability of a governmental agency to forecast with reasonable precision the complex variables which exist in a highly pluralistic society and which are undergoing constant and often significant changes. Many of the factors involved even extend beyond the realm of economic theory and, rather, are involved with those exogenous variables which impinge upon the operation of the economy but which, in fact, work beyond the control of either government planners or even the private sector. For example, no econometric model could have predicted the action taken last year by the Arabs in response to pressures because of the Middle East conflict and the impact of that embargo upon the economy of the United States and the world. Thus, any monolithic planning simply fails to grasp the essential core of the U.S. economy which is firmly based upon the reactions of thousands and millions of variables in a highly fluid and changeable environment made up of political, economic and social forces.

Second, the EIS begins by what seems to us an arbitrary determination, both as to the type of coal which will be developed, the locations where it will be used, and the specific markets which will consume it.

For example, the statement suggests that the first federal coal to be developed will be "high quality coal." The statement also suggest that the initial allocation of coal resource areas will be on "the basis of the least cost of

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delivered energy." The two statements are, in the first place, in conflict since very often the "high quality coal" will also be high cost coal in many instances not suitable for power generation or, at the very least, an inferior use for such purposes. Thus, in arriving at an arbitrary determination, the EIS creates at the very outset a dichotomy between the two criteria it proposes to use for the type and location of coal.

This dichotomy is carried over into the end use determination of coal. Apparently, for reasons that are not quite clear, the EIS arbitrarily excludes gasification and on-site electric generation plants from consideration for federal coal leases at this time. In so doing, the statement assumes the existence of certain inhibiting factors which make such end uses undesirable without clearly spelling forth what those factors are. In addition, in arriving at this conclusion, the EIS runs contrary to its own criteria of "least cost of delivered energy" by insuring that a large part of the federal coal reserve will not be developed expeditiously, and in fact, may not be developed at all. We refer specifically to the low quality lignite reserves in the Montana, North Dakota and northern Wyoming area which for reasons of both economics and technology should be developed either for gasification or power generation at or close to mine site.

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Indeed, if this is not done, there is every indication that these reserves will not be developed at all.

Thus, the EIS constructs a paradoxical situation to the extent that it purports to encourage the expeditious and diligent development of federal coal resources, while at the same time establishing criteria which arbitrarily exclude certain end uses from access to federal coal and at the same time exclude a large portion of available federal coal reserves.

Third, there is one final note which bears upon the determination of the market for a given goal at a given point in time. Quality is a relative term. High quality from coals is usually considered to be that which is low in ash and sulfur and high in Btu content. There is a relatively small amount of such coal existing in the West, located primarily in the state of Utah. Such coal is specifically suited for metallurgical purposes. On the other hand, there is a great deal of coal located in the western states and particularly under federal lands which is uniquely suitable for electric power and generation. The determination as to the particular market for which coal should go, and the unique application of that coal, is a determination made in the marketplace, a determination made by the buyers of coal and the sellers of coal who design consumption facilities to use coals which are available to them based upon price levels

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and needed quality. It makes little sense to consider the use of a metallurgical grade coal for power generation when a lesser quality but more abundant coal could be used just as well for that purpose.

We have some concern about the somewhat ambiguous language in the EIS relating to the time frame needed for development. As now constituted, the language suggests federal coal leasing programs for one fiscal year with the projection for an additional four years. We interpret this as leasing only, which we feel is too short and inflexible a time frame for practical application; also it is without inference that coal land must be developed in the time frame. However, since the language is ambiguous, we strongly urge that whatever revisions are made should clearly spell out that the leasing schedule is merely that--a leasing schedule--and that the responsibility for diligent development will be decided upon an individual basis given the type of end use, the complexities in mining, etc.

We were extremely disturbed by language in the EIS suggesting that EMARS could be applied to currently existing leases. We regard this as retroactive and perhaps a violation of existing law if applied to "producers currently holding federal leases." We do not believe that such legal retro-fitting is either desirable for the expansion of coal production in the West or necessary to fully protect the environment of the western area.

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Rather, all such retroactivity can do is to inject a new uncertainty into ongoing coal operations or into operations well along the planning stage. This uncertainty must impact upon the availability of western coal for the immediate future, a time most critical in America's energy history. Moreover, to the extent that the retroactive application of leasing regulations hinders the current operations of coal mines on federal lands, it injects a note of great uncertainty to future operations since potential investors in coal in the West must face the constant potential for the application of standards and regulations to them that were not contemplated at the time they began operations and that, in fact, were not the part of any legal obligation which they accepted as a part of securing a federal lease. Indeed, such an approach must provide a plan for the compensation of the current leaseholder.

In the development of any federal policy, the unique position of the federal government with respect to coal ownership must be considered.

The federal coal reserve approximates 145 billion tons. Of this total, more than 85 per cent is low in sulfur content and thus in demand because of sulfur limiting regulations.

The physical volume of federal coal tends to understate its impact. Since much of the federally-owned coal is involved in the checkerboard pattern, and since access to

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the federal coal in the checkerboard is essential to a viable operation, the federal lease is a critical component in transforming coal from the ground to energy availability to the consumer.

In theory, then, the federal government occupies a classical monopolistic position. It can, by withholding coal, or by the terms of its availability, drive up coal prices or depress them, insure rational marketing patterns or impose perverted ones, determine the production and marketing structure of the coal industry in the area of the federal lease and, in the final analysis, shape the design of the total coal industry in the United States.

It can do this in the classical monopolistic sense by determining what seems to be best for it at the time and then by shaping its policies to accomplish that end. Such policies may or may not be in the public interest and, more than likely, will reflect the views of the particular agency with the power over federal coal leasing. Particular agency administrators may not reflect the national will and could possibly reflect solely the particular and parochial views of that agency.

Such power is not to be taken lightly, whether in the hands of public or private monopolists. The fact that an economic power of this magnitude exists within the framework of an industry traditionally and still characterized by extreme market competition is a cause for added concern.

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In effect, the federal government by virtue of its monopoly position can come to dominate the entire marketing structure of coal much as the early coal carrying railroads did in the latter part of the 19th and early part of the 20th century.

We would hope that the federal government will not see fit to act in the classical manner of the monopolist, i.e., to maximize his profits. To the contrary, we believe that the government must use its awesome power inherent in its vast coal resource to maximize the public welfare, enhance the functioning of the free market system, and preserve, to the extent desirable, both the land values and the socio-economic character of the areas involved.

We would also think that the determination of the effectiveness of the federal coal lessing program should be measured against the totality of the national goals, not merely the money derived from federal leasing programs.

The importance of federal attitudes end the programs which will emanate from such attitudes can best be measured by the importance of federal coal to the industry. In our view, the future of coal as a private industry will, in large measure, be shaped by the way in which western federal coal is leased to private enterprise. In fact, because of the heavy and increasing demand for coal throughout the United States, and because of the huge reserves of federal coal

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available in the West, a great deal of the future ability of the industry to meet increasing demands will rest upon the availability of federal coal to the producing companies of the bituminous coal industry.

We, therefore, strongly believe that the federal leasing program must reflect both the need of the industry and the position of the federal government to meet that need. We believe that the governmental policy should be directed toward working cooperatively with industry rather than acting as a disinterested seller seeking merely to achieve the greatest monetary value for the product which it has to offer. In fact, if the governmental authorities determining the course of coal leasing decide to adopt this course, we believe that nothing but harm can come to the national well-being.

One of the prime considerations of the federal leasing policy should be the maximum availability of federal coal. This availability is essential within the framework of the coal industry which must double or triple its production for the next ten to fifteen years. It is also essential if rational planning is to be done by both the coal industry, the railroads which haul coal, the utilities and other consumers who make large front-end investments for the construction and operation of conversion facilities of one type or another.

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We accept, of course, the concept that maximum availability of federal coal must take place with a proper environmental framework. We recognize that there may be some instances where federal coal should not be developed because of the probabilities of irreversible damage to the environment or the loss of a unique land value such as a national historical monument. We also recognize that the federal government must take into account fair market value of leasing of its coal, and that the determination of such value will in some ways impact upon the amount of coal available for lease at any one time.

However, in a market characterized by extreme demand, it is quite apparent that a prime goal of federal coal leasing must be ready and widespread availability. Such availability is clearly within the national interest and indicated by the growing need of the United States for energy in its various forms.

It is our position that the most effective federal coal leasing program would be the resumption of the traditional federal coal leasing approach with the establishment of selective criteria to protect the environment. In essence, this would provide for the resumption of the issuance of prospecting permits and preference right leases, as provided in the Mineral Leasing Act of 1920, as amended, with the further requirement that selective criteria to protect the

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environment would be developed and incorporated in new permits and leases. Leases would, therefore, be issued where reclamation could be assured. The EIS examines this alternative with rather cursory treatment (alternate 1b., Vol. 2, p. viii - 129) and dismisses it on the basis that it would require single site consideration; development would be more random as a result. Prior to development and production, all mining operations on federal lands will be evaluated on a site specific basis whether a preference right lease or not. We can see no reason why prospecting permits and preference right leases cannot be issued within the framework of a regional plan which considers environmental protection and other resource values. In addition, pending requests for preference right leases should be processed.

If the decision is to go with a new federal coal leasing policy instead of the traditional approach, then we believe that EMARS must be modified significantly to make it viable.

One of the most fundamental questions involved in the federal coal leasing program is how much coal should be leased and where such coal should be leased.

The question of location should perhaps be addressed first.

As we understand the EIS statement, the basic part of the EMARS allocation system will be a market determination made by the federal government to ascertain the amount of

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federal coal which logically should be leased at any given time coupled with a predetermination of those areas which would be "best suited" for federal leasing to meet a predetermined market demand.

We must reject this concept.

We think that it imposes upon government a task which is simply not achievable by government within the context of a pluralistic economy marked by many and diverse competing forces, as stated above.

On the other hand, we do believe that the proper location of federal coal leases can best be done through the normal interplay between buyer and seller. An effective mechanism to determine the possible locations for federal coal leases should be through a readout from industry nominations as to area and reserve quantity. Industry is in the most intimate contact with the market and highly sensitive to both the direction of the market and changes in that direction. Thus, industry is in the best position to determine in what parts of the country and which particular segments of the federal coal holdings are best suitable to supply market demand at any given point in time. Through a system which permits an input from industry on this question the federal government can readily obtain a discernible pattern of both areas of interest and potential reserves required for lease.

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Once the areas of interest are determined, full public participation can then insure both the protection of the environment and a proper public input into individual tract selection and development.

This is not to say that all industry nominations will be accepted or that any tract of land requested by industry will be leased. Such a view is too simplistic and would ignore the legitimate right of the government to protect unique land values or to evaluate the specific reclamation technology required for the proper restoration of the specific sites involved. In addition, other considerations, such as an inadequate socio-economic infrastructure might indicate that such land should be reserved for a later time when conditions for developing it would be more favorable. However, for the most part, the route of industry nominations seems to us to be the best possible way to determine the location and quantity of federal coal required for leasing.

Additionally, where there is a coal reserve which can be developed and for which there is a buyer and a seller, that coal should be leased consistent with the need to protect the environment. Thus, as the market economy brings forth a need for a given volume of coal, a producer who will supply that coal and a consumer who will use it, we believe that the federal government should lease that coal under terms that best serve the public interest.

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Moreover, we believe that there should be enough reserves in a given area leased to insure that the various suppliers can meet a given competitive market. Such competition is the heart of a free enterprise system and will insure the fullest protection for both the consumer and the American public.

The EIS statement suggests one alternative, which is extremely disturbing to us. This involves the federal development of federal coal.

This alternative represents a major, and to us a catastrophic, departure from the established federal role of encouraging private business and thus constitutes a direct and immediate threat to the free market system of the United States.

There is ample provision in the law coverir the development of energy resources to indicate the ernmental policy of encouraging private enterprise. The Mi l and Mining Act of 1970, for example, states that it is ie continuing policy of the federal government in the tional interest to encourage and foster private enterprise in the development of the nation's mineral resources. The Atomic Energy Act of 1954, as amended, contains a specific provision which provides for the encouragement of private enterprise in that sector, even though there is a recognized and highly viable government presence in the nuclear field.

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There is ample reason for encouraging private development other than the fact that it has been the traditional route for economic growth in the United States.

Private industry is highly competitive and thus provides for a continuing check in the relationship between buyer and seller. Private enterprise is currently spending millions of dollars in the research, exploration and development of coal and related energy fuels and, if allowed to continue, will accelerate this effort. Under such circumstances, it is neither necessary nor desirable for the federal government to depart from the past patterns of enterprise development and assume the role of a competitor of the coal industry in the development of federal coal lands.

In addition, the entry of government would seriously distort competition in the industry. Its operation would be funded, at least in part, by subsidies or appropriations from Congress, thus shifting the cost from the consumer, where it belongs, to the general public in the form of higher taxes or of lesser services in other areas of the economy. Any artificially lower price for coal or for federally developed coal, would tend to stimulate demand for this source of coal at the expense of other competing private enterprise sources and thus externalize some of the costs of production of coal--a circumstance which is highly undesirable in many respects.

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Even if the governmental agency were forced to pay operating expenses out of its ravenue, the federal entity probably would not compete in the competitive lease sales and would not pay bonus royalties or other federal income taxes in connection with this coal business. Thus a government operation, when tied to the vast government ownership of the coal resource itself, would inevitably lead to a monopoly of coal production in vast sections of the United States, a monopoly which, even though held by government, is nonetheless extremely undesirable from the point of view of economic theory as well as from practical experience with such monopolies both in the United States and worldwide.

Sincerely,

Carl E. Bagge

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CEB/bjh

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June 20, 1974

Tinks
Final 3/15/74

Mr. Curt Berklund
Director
Bureau of Land Menagement
U. S. Department of the Interior
Weshington, D. C. 20240

Daer Mr. Berklund:

The American Mining Congress, a national association of United States companies that produce most of the nation's metals, coal and industrial and agricultural minerals, wishes to comment on the draft environmental impact statement regarding the proposed federal coal leasing program.

Because a large percentage of the nation's coal resources occur on public domain lands, there is need for immediate development of a federal coal leasing policy that will make this resource available in a timely manner and on terms that will permit economic development.

The American Mining Congress is aware that the Department of the Interior must have a policy for developing such a program and that resource potential, environmental factors, and costs must be given adequate consideration. In formulating a federal coal leasing policy, it is important that opportunity be given to all interested parties to comment on the leasing time frame and the determination of quantities of federally owned coal to be leased, taking into account both operating and environmental factors.

A federal coal leasing policy should be structured so as to preserve existing rights that were obtained from the federal government in good faith under the present leasing system.

In regard to the Energy Minerals Allocation Recommendation System (EMARS), AMC believes that the detailed planning called for in this program is not in line with capabilities that presently exist within the federal government to forecast future supply, demand, and use for coal. The program envisions

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Mr. Curt Berklund
June 20, 1974
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detailed planning of requirements for energy generated from coal on a regional basis; in our opinion, severe disruptions in the nation's economic system could result from faulty forecasting on this basis. The program envisions that reliable forecasts will be made as to where the coal will be transported and who will be using it. This is not in accord with the operation of the nation's economic system in which competitive market forces ultimately determine supply, demand, cost and end use.

Another concern is that the time frame for development of coal occurring on public domain lands is much too narrow. When coal resources are made available for development, sufficient lead time must be allowed in order to provide for adequate planning, construction time, and consummation of sales contracts.

One of the listed alternatives to the proposed coal leasing program is federal development of coal. The American Mining Congress is strongly opposed to this concept. The Mining and Minerals Policy Act of 1970 states that it is the continuing policy of the federal government in the national interest to foster and encourage private enterprise in the development of the nation's mineral resources. Any federal involvement in the actual mining of the coal resources would be a serious intrusion into the private enterprise system.

Sincerely,

J. Allen Overton, Jr.

J. Allen Overton, Jr.
President

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August 28, 1974

Hon. Curtis J. Berklund
Director
Bureau of Land Management
Department of the Interior
Interior Building
Washington, D. C. 20240

Dear Mr. Berklund:

This letter is a follow-up to the lengthy comments we have previously submitted on behalf of the Natural Resources Defense Council, Inc. with respect to the draft environmental impact statement prepared on the Proposed Federal Coal Leasing Program (DES 74-53).

While our previous correspondence set out our comments and suggestions for improvement in great detail, we have recently learned of some facts and reports which we believe are significant enough to bring to your attention directly for discussion in the new draft.

(1) The Report of the Interior Department's coal extraction task force, entitled "Coal Extraction R & D Program" (December 11, 1973) should be discussed in detail. This report reaches some significant conclusions that are at odds with several statements in the DES. It is yet another example of the failure of this DES to consider information directly relevant to the coal leasing program -- much of it generated by the Department itself! In particular, the report notes the paucity of data and the major research required to enhance coal production and to mitigate adverse effects. It observes that present data on available reserves are questionable and, perhaps most significantly, calculates that at least one possible leasing strategy would exhaust current surface mineable reserves in the West by 1996!

(2) The DES fails to consider, reproduce or even mention a table prepared by the U.S.G.S. Conservation Division which shows <u>Recoverable Coal Reserves on Federal Lands Committed to Leasing and Projected Production From Federal Coal Lease Lands for 1975 Through 2000</u>. This table, reproduced at page 8 of Senate Report No. 93-984 (Federal Coal Leasing Amendments Act of 1974 - July 3, 1974), shows that, at the estimated 1975

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August 28, 1974
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rate of production, the amount of federal recoverable reserves committed to leasing will last 540 years!

(3) FEA Administrator Sawhill's July 25, 1974 testimony before the Senate Interior Committee suggested that material and equipment supply problems will have an adverse effect on the expansion of the mining industry -- affecting projected increases in both coal and oil shale surface mining. This problem area, and the possible choice it may require between expanding oil shale and expanding coal production, must be thoroughly aired in the new DES.

(4) The BLM reportedly recently wrote lease stipulations in a North Dakota lease offering for land adjacent to an existing Consolidated Coal strip mine, which required three feet of topsoil to be segregated and separately replaced, in addition to two feet of topsoil previously treated. This was not considered or mentioned at all in the DES as a possible or desirable environmental protection measure.

(5) The Powder River Basin Resource Council (Box 6221, Sheridan, Wyoming 82801) recently inventoried existing Wyoming coal leases as follows: 502,660 acres under state lease in Johnson, Campbell and Sheridan counties; 60,124 acres under private lease in those counties; and 131,312 acres under federal lease in those counties and Converse County. This should be discussed in the required section on non-federal coal.

Obviously, this list is not exhaustive, but the items discussed hopefully will, when considered with our previously submitted comments, point the way toward a thorough consideration of all the issues that NEPA requires in the new DES.

Sincerely,

John D. Leshy, Esq.

Terry R. Lash, Ph.D.

JDL/TRL/ak

cc: Hon. Rogers C.B. Morton
Hon. Russell W. Peterson

These comments are submitted by the Natural Resources Defense Council, Inc. (NRDC) through its office in Palo Alto, California. NRDC is a non-profit, tax-exempt, corporation organized under the laws of the State of New York, with offices in Palo Alto, New York City, and Washington, D.C. NRDC is a national organization dedicated to the wise management of the nation's natural resources and the enhancement of environmental quality. It has about 20,000 members and contributors in the United States. Among the methods NRDC uses to achieve its objectives are: (1) monitoring the activities of federal and state governmental agencies to make sure that environmental values are fully considered in decision making; (2) improving agency decision making which affects the environment by submitting written comments on agency programs, participating in administrative proceedings, and filing lawsuits where legal duties are not being fulfilled; (3) providing information and assistance -- both legal and technical -- to individuals and organizations interested in making governmental agencies more responsive to environmental values.

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I

INTRODUCTION

The Natural Resources Defense Council, Inc. (NRDC) hereby submits these comments on the Draft Environmental Statement, DES 74-53, prepared by the Bureau of Land Management (BLM), Department of the Interior, concerning BLM's proposed federal coal leasing program. For the reasons stated below, we believe that the draft statement and the course of inquiry and study reflected therein do not satisfy the requirements of the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. §§ 4321-4347 (1970), and that the draft statement will not materially assist the Department of the Interior in achieving its important goal of orderly federal coal development consonant with the "application of the highest environmental ethic." (p. I-1)[1/]

Since its inception, NRDC has been concerned about the serious environmental problems associated with the surface mining of coal. Most recently, the Western Office staff has taken several actions on NRDC's behalf and on the behalf of regional environmental organizations and concerned individuals

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[1/] Page numbers in parentheses refer to pages in the draft statement unless otherwise indicated. The draft statement is hereinafter referred to as the DES, the draft EIS, or the statement.

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in respect to Western coal development.[2/] Our comments should be considered in light of this history of involvement with the issues surrounding the potential large scale exploitation of the coal resources in the West, especially in the Northern Great Plains. For brevity the material set forth in detail in our previous letters, comments and statements is not wholly repeated. We explicitly incorporate as part of NRDC's comments all of these other materials as they may pertain to the BLM's proposed federal coal leasing program and this draft statement.[3/]

[2/] For example, NRDC is a co-plaintiff in a lawsuit against the Bureau of Reclamation involving water rights and water resources development connected with the anticipated coal-based industrialization in the Northern Plains region. In addition, we have submitted detailed comments on proposed rules and regulations for the 1973 Montana Strip Mining and Reclamation Act, on the U.S. Geological Survey's proposed revision of coal mining operating regulations, on both the draft and the final environmental statement for Westmoreland Resource's mining proposal for the Crow Ceded Area, Montana, and on the draft and the final EIS on the USGS approval of the Peabody Coal Company's Proposed Mining and Reclamation Plan for its Big Sky Mine near Colstrip, Montana. We have also engaged in extensive correspondence with various state and federal governmental agencies regarding policies and regulations covering surface mining, and submitted, some 13 months ago, detailed suggestions to the BLM on the content of this programmatic EIS.

[3/] We particularly want to call attention to John Leshy's participation on an interdisciplinary team that was assembled by the Environmental Impact Assessment Project of The Institute of Ecology to prepare detailed comments on this draft environmental statement as part of the Project's efforts to improve the quality of environmental decision making under NEPA. His contributions to the Project's comments were related primarily to legal analysis and leasing policy, and are reflected to some extent herein. We also point out that in May 1973 NRDC raised many of the points discussed herein in a lengthy letter to the then Director of the BLM containing suggestions on the content of the programmatic statement concerning federal coal leasing policy.

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In general, NRDC finds that the draft statement fails to meet the strict requirements of NEPA. <u>First</u>, the statement lacks a precise definition of the proposed action. <u>Second</u>, the scope of the statement is too narrow in its consideration of major topics, ignoring almost totally the end use of mined coal. <u>Third</u>, important issues, such as the rehabilitation of mined land, are treated only cursorily and without inclusion of adequate analytical and scientific detail. <u>Fourth</u>, there is no or wholly inadequate consideration of realistic and potentially superior alternatives, such as continuing the existing moratorium on federal leasing, to the proposed action. We find that the draft statement obfuscates the important issues, rather than clearly delineating them for decision makers in the executive branch and in Congress. There appears to have been virtually no serious forethought given to the presentation of the information that is required in the draft statement for orderly, well founded decision making regarding the role of federally owned coal in meeting societal goals.

So far from being the full disclosure document required by NEPA, this draft statement appears to be simply a flimsy attempt to meet only NEPA's procedural requirements while ignoring almost totally its clear substantive mandate to improve federal agency decision making. The Department of the Interior by issuing such a wholly unsatisfactory statement makes a mockery of the NEPA process.

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Furthermore, we believe not only that the present draft statement is wholly inadequate, but that it is premature to prepare a programmatic statement on federal coal leasing (a) while there are still serious gaps in information about the nation's coal resources and the environmental constraints potentially restricting development of known coal deposits, and (b) while a federal energy policy fully assessing the proper role of coal -- including both private and federal, Eastern and Western coal -- in meeting the nation's legitimate energy needs has yet to be clearly enunciated. Without a significantly improved informational base and overall federal energy policy, reasoned decisions cannot be made concerning the future development of federal coal. The major informational gaps include, but are not limited to, the following:

(A) <u>Raw Data Needs</u>

1. There are no reliable figures on the private and state coal reserves under lease or otherwise available for development.

2. There are no reliable figures on the amount of federal coal reserves available for development.

3. There is great uncertainty about the presence of, and danger posed by, potentially toxic trace minerals in federal Western coal.

(B) <u>Role of Federal Coal in Total Energy Mix</u>

1. It is not known or revealed how much coal will have to be mined in order to meet the nation's energy needs, and/or the announced goal of eventually making the United States

-6-

independant of foreign imports for energy requirements.

2. It is not known or revealed how much federal coal will have to be mined to meet the nation's need for coal.

(C) Federal Coal Presently Leased Or Applied For

1. It is not known or revealed how much coal under federal lease is already committed for extraction and use, nor to what use it will be put.

2. It is not known or revealed generally how environmentally protective controls will be applied to development of coal already under federal lease.

3. It is not revealed whether or how many of the presently pending applications for preference right leases will be granted.

4. It is not known or revealed how much federal coal already under lease should not and will not be mined for environmental reasons.

(D) Technological Developments

1. It is not known or revealed how developments in the technology of making synthetic fuels from coal will affect the need and demand for federal coal.

2. It is not known or revealed how coal washing or stack gas scrubbing technology will affect the need and demand for federal coal.

3. Additional research must be completed before it is known to what extent surface mined lands in the Northern Great Plains can be rehabilitated at reasonable cost.

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4. It is not known or revealed how reclamation and land rehabilitation technology and feasibility should affect the appropriateness of engaging in further federal leasing.

5. It is not known or revealed how development of new underground mining technology should affect the appropriateness of engaging in federal leasing for surface mining.

Fortunately, there appears to be sufficient coal available to industry, much of it from undeveloped areas already under federal lease, to provide for the nation's requirements in the short-term. The committed reserves of federal coal are significantly less than the total (federal and non-federal) of 17 billion tons for gasification and power plants which the DES says is committed for use through the year 2000. (p. I-199) This figure is to be compared to the estimation of 22 billion tons of minable reserves already under federal lease or preference right lease application. (p. I-206)[4/] In other words, even generously assuming that more gasification plants will be built in the West than is likely in the near term and making allowances for numerous additional, as yet unidentified coal-fired power plants, there is ample federal coal already available for the production of electricity and synthetic gas. A continuation of the existing moratorium on

[4/] As discussed in detail below, we believe that there is substantial uncertainty in the estimation of both committed reserves and the available reserves of federal coal. The existence of these uncertainties on the whole reinforce the point that there is no need to lease more federal coal for at least several years.

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federal leasing need not hamper progress toward achieving a reliable, adequate energy supply in the United States.

Coal is an important, irreplaceable natural asset that must be consumed judiciously if we are to act properly as "trustees of the environment" as required by NEPA. Although the United States is generously endowed with coal compared to the rest of the world, that does not mean this resource is so abundant that we do not have to be concerned about its rate of use or how it is extracted and used. Because coal is the nation's major potential source of hydrocarbons, which form the basis for synthetic materials, including plastics and pharmaceuticals, we should not allow immediate consumption to penalize future generations that may rely heavily upon coal for these vital needs as well as for energy.[5/] This is especially important in light of the relatively rapid depletion of alternative hydrocarbon resources such as natural gas and petroleum. Thus, on this basis alone, the presumption should be to keep coal mining and utilization to the lowest practicable levels.

Also, there are important health-related and environmental reasons for not using coal directly for production of electrical energy. These are the same reasons that coal utilization in

[5/] "[I]n all likelihood, our appetite for coal, especially as a hydrocarbon base for industrial processes, could actually surpass coal's energy role." (John C. Sawhill, Administrator, Federal Energy Administration, Remarks before the National Coal Association, June 17, 1974.)

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power plants, until arrival of the "energy crisis," has decreased markedly during the past two decades. (p. I-58-60) Earlier surface-mined areas have not been adequately "rehabilitated" and proposed areas for leasing in the West may not be capable of being "rehabilitated" at reasonable financial cost. Coal-fired power plants release huge quantities of ash, sulfur oxides and toxic trace minerals, and, in some cases, radioactive materials. It is these very undesirable aspects of coal utilization that should argue strongly for minimizing the leasing and mining of coal.

To a large extent our comments are premised on the belief that this draft statement is so deficient on its face that a new draft programmatic environmental statement will have to be prepared and circulated for public and agency comment well in advance of an end to the current moratorium on federal coal leasing.[6/] That is to say, our analysis is aimed more at improving the required new draft statement, than at providing a detailed, comprehensive catalogue of the numerous serious deficiencies in this draft statement. The statement should be completely rewritten with careful attention given to each major issue raised herein and in the comments of others. Furthermore, the Department should reevaluate each section of the statement to determine whether or not all relevant information is fully

[6/] A separate discussion of the legal requirement for a new draft EIS under NEPA is attached hereto as Appendix B.

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disclosed and whether or not the information is presented in a manner that materially aids the decision maker in weighing and balancing the benefits and costs of each reasonable alternative.

We initially discuss the appropriate role and content of the first programmatic statement on federal coal leasing and how the issued draft statement generally fails to meet these criteria. We then turn our attention to particular environmental and legal issues that are inadequately considered or not considered at all in this draft statement. Finally, we make some suggestions that could assist the Department of the Interior in preparing and releasing adequate environmental impact statements on coal leasing and mining in the future.[7/] These suggestions are offered in the spirit of, and are calculated to help the Department achieve, its announced "overriding goal" -- to assure maximum environmental protection in its coal leasing program. (p. I-137)

7/ A detailed suggested outline of the contents of a programmatic statement is attached hereto as Appendix A.

NATIONAL AUDUBON SOCIETY
950 THIRD AVENUE, NEW YORK, N.Y. 10022 (212) 832-3200 Cable: NATAUDUBON

30 August 1974

Honorable Rogers C.B. Morton
Secretary of the Interior
Department of the Interior
Washington, D.C. 20240

Dear Secretary Morton:

The National Audubon Society has reviewed with interest the Draft Environmental Impact Statement on the proposed federal coal leasing program, issued by the Bureau of Land Management. We are very concerned about the potential for environmental degradation due to large scale coal development in the West. We feel that the federal coal management policies, must, therefore, be closely scrutinized.

The Draft EIS is far from adequate. In the first place, it is not clear what is being proposed, if anything. There is the repeated inference that the Department would like to expand federal coal leasing, but the critical questions of when, where, how, how much, why and under what conditions are not addressed.

Although we agree that the Department should "go public" before irreversible decisions are made, we find this EIS of little assistance in illuminating the possible alternative actions, and therefore it fails the objective of "going public."

We note that the present moratorium on coal leasing was established in order to provide the Department an opportunity to assess and reform its coal management policies. It had become apparent several years ago that vast quantities of federal coal had been leased without corresponding development and further, that departmental actions relating to coal development would have to be brought into compliance with NEPA. If this EIS is any indication, the Department has not progressed very far since 1971.

Honorable Rogers C.B. Morton
Page Two
30 August 1974

It appears now that the Department would like to lift the moratorium, without, however, fulfilling the following prerequisites that we feel are absolutely necessary:

1. The necessity to demonstrate the need to renew leasing. On the contrary, the Department's own figures show that more federal coal is under lease already than could be developed for many decades.

2. Congress has not yet passed strip mine legislation. Until it is certain that strip mining will take place only under strong regulation, with guaranteed reclamation, it is premature and inappropriate for the Department to promote additional large scale western coal development. We hasten to add that if the bill now in Conference fails final passage, or is vetoed, leasing should not go foward until the next Congress has a chance to act.

3. Congress has only begun to revise the mineral leasing laws. Again, it would be premature to begin a new leasing initiative in the expectation that the basic laws will be changed.

4. The Department should put its house in order with respect to existing leases and preference right lease applications. It is not clear from the Draft EIS whether the Department can or will exert effective environmental controls over development on the hundreds of thousands of leased acres in the West. If pending preference right leases are granted, the problem is further compounded.

5. Basic information concerning federal coal resources and the impacts of coal development has not been put together by the Department. No inventory of federal coal lands -- leased and unleased -- is contained in the EIS, and no comprehensive impact analysis has been prepared. Without this information, neither the Department nor the public is in any position to make major decisions concerning development.

In summary, we feel that the Department has offered no compelling reason to lift the leasing moratorium; on the contrary, the evidence indicates compelling reason to extend it. Indeed, we firmly recommend that the moratorium be continued.

Honorable Rogers C.B. Morton
Page Three
30 August 1974

In addition, the Draft Environmental Impact Statement is so woefully inadequate that a new draft should be issued, rather than a final EIS. The Department's express desire to bring its coal information policies into compliance with NEPA has by no means been achieved by this draft. For a comprehensive review of the draft statement, we commend to you the critique prepared by The Institute of Ecology.

The Department of the Interior, because it controls so much of the western coal resource, is in a critical position. In the absence of concerted environmental protection, the Department's actions will promote widespread degradation of the quality of life in the West.

Thank you for your consideration of our concerns.

Sincerely,

Charles H. Callison

CHC:bs

Charles H. Callison
Executive Vice President

WYOMING OUTDOOR COUNCIL

June 27, 1974

Secretary Rogers Morton
Dept. of Interior

Dear Sir:

The following are comments pertaining to the Federal Coal Leasing Impact Statement:

1. Moratorium -- the environmental impact statement offers no compelling reasons to lift the moratorium on coal leasing. The burden is definitely on your Department to show why coal leasing should be renewed.

2. Coal under lease right now-- How can the Department control and deal with the vast quantities of coal already under lease? There is already more coal under lease now than could be utilized by the year 2000. How do you intend to oversee environmental safeguards over these leases, and why are you even considering any additional leasing at this time? The environmental statement fails to adequately answer the above questions.

3. New Statement-- I feel that your environmental statement is extremely inadequate and that your people should go back and write a new comprehensive statement. Your discussions are confusing, unclear, and often sketchy -- much of the statement requires considerably more information before viable alternatives can be digested. We cannot approve nor accept this environmental impact statement in its present form.

Finally, your discussions of energy alternatives seems to sweep away all viable sources (wind, solar, methane) solely on an economic basis -- and because the energy corporations could not make enough profits. Many of us out here in the West feel that our way of life is a mere minor stumbling block to the eventual rape-scene for coal. The top Federal decision-makers are only paying limited lip-service to energy alternatives and to limits to growth. I hope that you can show us more imagination and fortitude than that.

Sincerely,

Bart

Bart Koehler
Executive Director

c.c. Sens. Hansen, McGee, Rep.Roncalio

North Dakota Wildlife Federation

Publishers of FLICKERTALES
North Dakota's Leading Environmental Publication

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P. O. Box 1694
Bismarck, North Dakota 58501

Phone 223-8741

6-28-74

COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT
PROPOSED FEDERAL COAL LEASING PROGRAM

The North Dakota Wildlife Federation appreciates the opportunity to comment on the draft environmental impact statement dealing with the proposed federal coal leasing program.

The NDWF is a non-profit citizen's organization with a state-wide representation of over 7,000 individuals concerned with the state's environment and natural resources.

Our comments are largely confined to North Dakota and the Northern Great Plains Coal province.

In general, we feel that much of the impact statement is couched in phrases that make it appear that it was written by the energy industry rather than by an unbiased government agency. The statement appears to presume that western coal is the only immediate answer to the nation's energy problems. In many places it reads like the series of advertisements currently running in national magazines and paid for by the American Electric Power System.

The Advertisements criticize sulfur dioxide control devices and state: "....there are better, safer ways to protect the public health and welfare. One is to release the vast reserves of Government owned low-sulfur coal in the West."

A good deal has been written lately that when the BTU content in western coal is compared with that of eastern coal, the sulfur content is not all that different.

Page I-6 of the impact statement says that "the environmental impact of diminished levels of sulfur dioxide emissions from Midwestern plants using low sulphur Federal coal from the western states has not been analyzed in any detail."

Is low sulfur in western coal a myth based on tonnage rather than BTU's?

We also question why the federal coal leasing program should be reinstated when the Council on Economic Priorities reports that only 11 per cent of the 474 existing leases it examined were not under production, and 321 leases "have never produced a single ton of coal." Instead of producing coal, these leased lands are being held largely by big corporations speculating on coal prices to rise, says the CEP.

Page I-9 talks about going "beyond production for domestic consumption to the additional capability to export substantial quantities of petroleum products and feedstocks."

— AFFILIATE OF THE NATIONAL WILDLIFE FEDERATION —

(cont.)

BLM coal leasing--2

The reason given is to effectively counterbalance possible manipulations of other countries by oil rich areas. We question the wisdom of sacrificing food producing areas for energy production when the next shortage in the world may be food. Already this is evident in many parts of the world.

Page I-11 says, "Action programs adequate to meet critical energy needs must proceed further and faster than many would like. And certainly far in advance of our ability to completely analyze all of the complex cause and effect relationships that are involved." Such action may be in the interest of the energy industry, but we sincerely doubt if it is in the interest of the public.

I-124 states that the mining supervisor has the authority of enforcement to prevent pollution, protect other resources, and rehabilitate the land according to plan after mining. This is an outsize job for a government agency which currently has difficulty in preventing cattle from over-grazing in some areas. We are talking about huge corporations massively stripping the earth!
I-142 says that the BLM will determine "the adequacy of environmental protection and rehabilitation aspects of all mining operation plans" where it has surface management responsibilities.

Incidentally, the map on I-186 is of North Dakota rather than of South Dakota.

In all of section IV, it is difficult to tell when the impact statement is talking about underground or surface mining. The statement alludes to surface mining on occasion, but it tends to be out of context.

III-8 describes how seriously badland areas are affected by surface disturbances and makes an excellent case for their not being mined. III-60 points out the scarcity of water on the Northern Great Plains and the harmful effects of altered hydrology. Water drainage patterns do not have to be altered if mining plans are drawn up to skip sensitive areas and maintain their vegetative cover. Woody draws in North Dakota should not be mined (page III-62) for the very reasons stated. North Dakota has fewer trees than any state in the nation and the draws are some of the finest wildlife habitat in the state.

IV-1 concedes that legal controls--federal, state and local--are not yet at optimum effectiveness even though they are essential to mitigating coal impacts. This is a further reason for delaying leasing.

We sincerely doubt the statement: "The desire to be thought well of and accepted by environmentally concerned citizen consumers reinforces and inspires ethics on the part of the coal industry." (IV-2). They have not demonstrated this in Appalachia.

III-62 says that the topography of the "Prairie pothole" waterfowl production area can be recreated through reclamation. We doubt this also.

IV-8 talks about emphasizing the beneficial aspects of change. It says "all manner of services, such as more intensive game and fish

(cont.)

BLM coal leasing--3

management to sustain hunting and fishing opportunities, and community recreation facilities should be planned in advance...." Who will pay for this?

IV-10 says that federal statutes will serve to mitigate the impact of coal operations "if adequately applied and enforced." We see this as a big "if" considering the size of the proposed operation. IV-15-18 talks of many things that "should be" done to mitigate impacts. It would be more reassuring if it said they will be done.

IV-29-31 point out: "In the drier zones and parts of them in the semi-arid West, rehabilitation is still in an experimental stage.... None of the (reclamation) programs has continued for an adequate time to demonstrate that the vegetation will be successful." It further points out that sodium is a primary problem in the West. And then it quotes the Council on Environmental Quality that "area mining in the far West may well be unacceptable unless vegetation can be re-established." We agree with all of these statements. *

Under actions necessary to protect soils (IV-31), the word topsoil should be changed to top material, since some areas have little or no topsoil". However, top material is better for plant growth than lower layers.

There is no mention in this area of the distinct possibility of increased saline seeps after mining. Such seeps are a growing problem in this area.

IV-44 says that exotic Russian Wildrye may be a last resort in areas of low precipitation and saline soils. The Agricultural Research Center at Mandan has reported that it is not adapted to conditions in North Dakota. *

IV-47 emphasizes that "fertilizing programs must include maintenance applications... to perpetuate the desired vegetative cover." How long must these continue and who will pay for the continued maintenance. IV-48 says that "for semi-arid lands, revegetation may require effort for 30 years or longer."

We find the effects on wildlife very disturbing. IV-49 says that "Although rehabilitation of big game winter range has been successful in some areas, due to a variety of inherent environmental and land management problems, it can generally be expected to be the least successful in areas where it is the most crucial."

The statement continues that "in order to mitigate the impacts of increased human pressure and increased access on game and fish populations, more restrictive hunting and fishing regulations will probably be established." Is this loss considered as a cost in determining a cost-benefit ratio of developing Western coal?

IV-58 and 60 say that the Antiquities Act of 1906 can be a mitigating measure in protecting archeological and geological values of human interest. Yet all these statements are couched with the phrase "if it is enforced." Will it be enforced?

*see page 6 (cont.)

BLM coal leasing--4

IV-74 says that all operations must be conducted in accordance with requirements of the Federal Water Pollution Control Act and the Clean Air Act. Yet we are all aware that the Clean Air act is being weakened to allow this very development. Also water pollution from a large mining operation may be considered a non-point source, which is difficult to deal with under the water pollution act. Also the Administration has refused to release funds for the implementation of the act.

V-4 alludes to illegal drilling on federal lands during the moratorium on prospecting permits. This does not assure us about the ethics of the coal industry mentioned on IV-2.

V-16 says "air quality will inevitably be degraded, at least temporarily and locally...." Further on it says "No immediate techniques exist to individually control emissions of hazardous trace elements, beryllium, mercury, cadmium, chromium, nickel, selenium, arsenic and manganese." What will be the effects on the people who live in this area? Is their deteriorating health figured as a cost of this development?

V-22 deals with ecological relationships: "The time required for equilibrium ranges from decades to a few hundred years in areas of high rainfall to many hundreds of years in arid climates, more particularly those with less than 10 inches of precipitation annually." How will this area survive during the period between the end of coal mining and the return of equilibrium?

We disagree with the top photo on V-27 that "small quantities of pollutants will go into the air when coal is burned to generate electricity." The Four Corners plant alone is reported to belch 200 to 250 tons of pollutants into the air every day since 1964. And the proposed plans for this area are even larger.

VI-3 says "The abundance of and accessibility of Federal coal makes it an important fuel reserve for national security. The fact that most Federal coal can be mined by surface methods, which can be operational more quickly and with smaller investments and less personnel than underground mining, enhances its value for defense purposes." Why then are we mining this now during peacetime, when there is so much more coal that can be deep mined, including low sulfur coal nearer the load centers.

VI-4 paints a nice picture of the positive value of mixing cultures in a mining community. A Yugoslavian Tamburitza band at a county fair or an Italian wedding sounds idyllic. But this doesn't appear to be happening at Rock Springs, Wyo., for example, where people live in tents without adequate sanitary facilities due to housing and other shortages. Nor is it happening at Gillette, where a syndrome has been named after the town by sociologists. It is more like the description on V-7: "....rates of delinquency, crime, personality disturbance, alcoholism, alienation and rootlessness...."

VI-11 suggests that as a substitute for hunting, tourists will visit the mining operation for recreation. This is a poor substitute.

VI-13 makes a good case for complete reclamation, which should

(cont.)

BLM coal leasing--5

be mandatory in every lease. Even a cost of $5,000 per acre for rehabilitation of mined lands is less than a fifth of the mine-mouth value of the coal mined in 1972. The country does not owe the coal companies a handsome profit. Logically, the coal companies should owe the public the complete restoration of public lands it destroys by stripping. Future generations will pay the cost in lost food production if land is not completely rehabilitated.

VI-14 is a key statement: "Suffice it to say that carefully located and planned extraction of Federal coal with accompanying rehabilitation, generally produces values in excess of the immediate loss of non-coal values plus the long-term loss in productivity of the rehabilitated land."

We know the immediate and long-term losses are going to be real. But there is no assurance that the first part of the sentence (which we have underlined) will in fact happen. All three of these things--careful locating and planning before extraction and followed by rehabilitation should have the force of law behind it before further leasing is allowed.

If this is not done, the sentence may as well read that it is worth destroying a clean agricultural and recreational area so that the big cities can continue life as usual with cheap power.

The last sentence on VII-9 says it, not only for historic but all other human values: "Impairment can be a cumulative thing so that after a long period of time nothing really original or authentic exists."

Section VIII talks about alternatives. But alternatives to fossil fuels are given superficial treatment. We found no mention of magnetohydronamics (MHD) as being a more efficient method of producing power from coal. And deep mining of coal is down-played to strip mining. Strip mining is said to be cheaper and safer. Yet the ultimate cost of stripping is not yet known in terms of land producing again and the altering of vital water patterns in semi-arid states. Some companies doing underground mining (U.S. Steel, for example) have a better safety record than some strip mining firms. Apparently xxxxx deep mining can be made a lot safer than it now is. There also is no mention that most of our vast coal reserves are too deep to strip mine and will eventually have to be deep mined.

In dealing with alternative power sources, VIII-2 says that: "While the possibility exists for some shifts of the labor force, particularly if alternative energy source measures were brought to bear, it can be expected that the net impact would be to increase unemployment and reduce the gross national product."

But strip mining will create these problems also. Stripping the West will bring about a major east to west shift of the labor force, creating more unemployment in already hard-pressed Appalachia. At the same time it will create social problems already mentioned in the West. Strip mining will employ fewer laborers than deep mining, further creating unemployment. The statement elsewhere observes that "incentive capital put into synthetic fuels industry would add strong inflationary pressures to the domestic economy."

(cont.)

BLM coal leasing--6

Strip mining in the northern plains also threatens the agricultural base of the region. What will these actions do to the country's economic stability?

VIII_117 talks about energy conservation and that there is little incentive to cooperate. One of the biggest incentives is a rise in the cost of energy. People are shifting to smaller, gas-saving cars, for example, with the rising cost of gasoline. The cost of power should reflect the cost to the environment and to human values. One area of the country should not have to pay the cost for another area. Power has been wasted because it has been "penny cheap." We can no longer afford it.

In conclusion, we support a continued moratorium on federal coal leasing until more information is gathered and assessed ((the NGPRP studies are not yet completed), adequate planning is done and legislation setting a national energy policy is passed. It is the Congress that should be setting a national energy policy rather than the Administration and its Department of Interior.

Sincerely,

Konrad Norstog

Konrad Norstog
President-
North Dakota Wildlife Federation

Footnote 1
The primary problem in ND strip-mining is the sodic condition. Salinity may also be a consideration in some areas. Saline soils should not be confused with sodic soils. In saline conditions the salts are in solution, sodic soils have sodium that is electrically bonded to the soil particles (ionized). The sodium therefore is not subject to leaching and is very stable. Probably the only practical method of altering sodic soils would be chemical in nature. At the present there is no proven method of so doing.

Footnote 2

It is stated that grasses are shallow rooted (18" to 24"). This is in error. Native grasses root to depths of 6' to 8'. It also states that Russian Wildrye is a last resort. This is also in error. Russian Wildrye is an excellent forage grass and does very well on alkaline soils, but when conditions get really bad there are many better varieties. In order of tolerance they would be----1. Alkali Saketone, 2. Tall Wheatgrass, 3. Carrison Creeping Foxtail, with Russian Wildrye, Tall Alta Fescue, Mandan 759 Pubescent Wheatgrass, and Western Wheatgrass bunched quite closely. There is considerable differance in the moisture requirments of the above grasses.

Bureau of Land Management
Department of Interior

The following organizations have read and concur with the comments of the North Dakota Wildlife Federation on the on the Draft Environmental Statement for Federal Coal leasing.

We further feel that an impact statement of this nature should deal with present and other possible uses for this land. It should not be devoted solely to mitigating the impact of coal development.

North Dakota Citizens Committee for Energy and the Environment.....
June Thompson   June Thompson , Sec'y , Bismarck

North Dakota Sierra Club.....Rev. A.W.Roos, Pres., Steele
I W Roos

Lewis & Clark Environmental Assn. of Bismarck-Mandan ....
Bernice Palmer, vice president
Bernice palmer

BRUCE J. TERRIS
HELEN COHN NEEDHAM
SUELLEN T. KEINER
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1908 SUNDERLAND PLACE, N.W.
WASHINGTON, D. C. 20036
(202) 785-1992

August 30, 1974

Director
Bureau of Land Management
18th & C Streets, N.W.
Washington, D.C. 20240

Dear Sir:

Enclosed are the comments of the Sierra Club concerning the Draft Environmental Impact Statement of the Department of Interior on the Proposed Federal Coal Leasing Program (DES 74-53).

Sincerely,

Bruce J. Terris

BJT:eb
Enclosure

COMMENTS OF
THE SIERRA CLUB CONCERNING
THE DRAFT ENVIRONMENTAL IMPACT STATEMENT
OF THE DEPARTMENT OF INTERIOR
ON THE PROPOSED FEDERAL COAL LEASING PROGRAM
(DES 74-53)

The draft environmental impact statement issued by the Department of Interior on the proposed federal coal leasing is grossly inadequate. Indeed, despite its bulk, it is so lacking in substance that it almost defies intelligent analysis. The Department of Interior has itself admitted the inadequacy of the statement in a Memorandum from Assistant Secretary Hughes dated May 1, 1974:

> I have reluctantly released the draft EIS on the coal program. In my opinion, it still has major weaknesses, but in the light of the many times it has already been sent back for revision, and because of the importance of getting the Department's decisions made on the outline of a new coal program, I think on balance the statement should now go out for comment.

Secretary Hughes then admitted that numerous important issues were "not well explained," "barely mentioned," "not discussed," analyzed in a "very thin" manner, or "not sufficiently analyzed." The Sierra Club's comments will therefore only discuss some of the statement's worst defects and the major subjects which are either not adequately considered or not discussed at all. 1/

THE OVERALL STATEMENT

The statement, while voluminous, is largely filled with materials of little or no use in analyzing federal actions to be

1/ The ineptitude of the statement is perhaps symbolized by the fact that the covers on the statement's two volumes include the word "environmental" four times, and each time it is spelled incorrectly. Unfortunately, the statement is substantively no better than its spelling in considering the important environmental issues involved.

-2-

taken relating to coal leasing. For example, the statement includes a rudimentary description of coal mining from exploration through rehabilitation (I-74 to 126) without any analysis of the difficulties which are involved relating to environmental protection. It has lists of all federal statutes and regulations concerning coal mining (I-131 to 135), without analysis of how they relate to the environmental issues which the statement is purportedly discussing. It has 13 pages of standard, simplified discussion on ecological interrelationships (II-1 to 13). Then, there are 212 pages (II-13 to 225) which describe "only briefly and in the broadest terms" (II-1) the geography of the various coal regions. These pages include long lists of animals, birds, and soils, general discussion of topography, present land use and other subjects, and pictures of animals and scenery. It is hard to understand what use this material could possibly be to any decision makers. Yet, as we will see below, the statement fails to give information which is vitally needed for intelligent decisions to be made. There appears to have been no consideration as to what specific, important issues would have to be decided and therefore what information would be necessary in making these determinations. In short, this statement consists largely of "padding" rather than a serious attempt to analyze the serious environmental issues involved.

THE SUBJECT OF THE STATEMENT

An environmental impact statement is of course required to be a "detailed statement" relating to "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. 4332(c). The first section of an environmental

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statement therefore usually consists of a detailed analysis of the particular federal action being considered.

This statement unfortunately fails to describe, even in general terms, what federal action is proposed. The very first page of the statement recognizes the need for such analysis by stating that "[t]he Secretary announced * * * that a programmatic environmental impact statement would be prepared, as soon as details of the long-range [leasing] program were established" (I-1). The next section, entitled "Proposed Action and Alternatives" (I-1a to 5), is just four pages long. That section describes the proposed federal actions as the Energy Minerals Allocation Recommendation System (EMARS) which is described as "a program of competitive coal lease sales for Federal lands" (I-1a) and the revision of certain regulations concerning leasing and mining federal coal reserves. Subsequently, the statement purports to set forth its purpose (I-5):

> It is a programmatic statement describing the Federally-owned coal resources of the United States, the pattern and impact of the Bureau of Land Management's national coal leasing program before 1973 and the anticipated environmental impact of competitive coal leasing upon implementation of EMAR procedures.

This comment gives no indication as to what federal action is being considered. 2/

2/ The suggestion that the statement is intended to consider "the anticipated environmental impact of competitive coal leasing upon implementation of EMAR procedures" is nonsensical. The statement should consider, in part, the environmental impact of EMARS procedures on coal leasing. In any event, the statement does not consider the impact of coal leasing on EMARS procedures.

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The statement does not adequately analyze either EMARS or proposed new federal regulations. While EMARS is described in slightly more than three pages (I-1a to I-5), this description is in the most general terms. For example, the statement says that "[g]asification, electric generation and other large scale on-site uses often pose complex problems" and that they "will be considered in EMARS tract selection procedures (I-3), but nothing is mentioned as to how this will be done. It states that the allocation recommendations "will include definite rehabilitation objectives" (I-4) but no indication is given as to how they will be arrived at. It claims that "[b]ase resource data will be adequate in all cases" (I-4) but no suggestion is given as to what this data will be or how it will be obtained. Most importantly, the specific criteria for making the important decisions involved are never set forth. There is no possible way for either the decision maker or the public to evaluate the environmental effects of EMARS or the alternatives to it without knowing what criteria will be utilized.

Moreover, the statement does not analyze the environmental effects of alternatives to EMARS. All the discussion, as to both the environmental effects and alternatives, appears to be based on the desirability or undesirability of federal coal leasing. This is of course not the same as analyzing the desirability or undesirability of the particular features of EMARS. However, since EMARS is not described in any detail, it would have been impossible

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to draft an environmental statement which would adequately analyze the environmental effects and alternatives. 3/

While the proposed regulations are included in the appendix (Appendices D and P), it is difficult to believe that these are really the proposed federal actions considered by this statement. These regulations were proposed on October 30, 1973, and no further action has been taken. Moreover, the proposed regulations are described only generally in the statement (IV-72 to 78). It fails to analyze the purpose of the regulations, their effectiveness in preventing environmental damage, or alternative provisions which might be adopted. The alternative section says only (VIII-135):

> E. <u>Modify regulations to control development of leases.</u>
>
> Environmental protection can always be enhanced by strengthening existing regulations if needed. USGS is currently proposing changes in their 30 CFR 211 procedures. Numerous Governmental regulations ranging from surface management to water quality enhancement influence coal development and mined land reclamation. The USGS operational procedures have been discussed in the Mitigation section of this document, while the exact regulations are contained in the Appendix.

Thus, the statement cannot meet the requirements of the National Environmental Policy Act as to the issuance of these regulations. 4/

3/ Secretary Hughes' memorandum admits that the description of EMARS "is somewhat out of date," barely mentions the use of nominations, and does not discuss alternatives at all.

4/ Secretary Hughes' memorandum says that the "draft [statement] does mention [the regulations] but the analysis of their impacts and of environmentally less damaging alternatives is very thin."

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As we have noted, the federal action which the statement appears in reality to consider is the resumption of federal coal leasing rather than either EMARS or the proposed regulations. While this is never said in the statement and particularly not in the section which purportedly describes the proposed action, the actual content of the statement appears related to federal leasing more than any other subject. Moreover, the summary of the statement says that the "Name of the Action" is:

> Proposed resumption of nationwide coal leasing by the Bureau of Land Management, upon acceptance of final environmental impact statement, utilizing the Energy Mineral Allocation Recommendation System. This program primarily involves 85 million acres of identified coal reserves located in the Northern Great Plains and northward along the continental divide from New Mexico and Arizona through Montana.

If we assume that this is really the federal action as to which the statement was issued — despite the fact it is never identified as the action in the statement itself — the statement still inadequately analyzes that action. The content of the proposed program for resuming leasing is never described. The statement does not analyze the number of acres which might be leased, the specific content of EMARS which will be used, or the criteria for making decisions.

In short, the present statement appears to consider the broad and undefined question whether federal leasing generally is desirable or not. This is not a federal action. Any statement which is issued must, in order to comply with the Act, describe and then analyze the environmental effect and alternatives to a specific federal action or program.

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ASSUMPTIONS OF THE STATEMENT

The statement makes a series of assumptions (II-8 to 10) without any meaningful explanation. These assumptions are not obvious. For example, the statement says that "[I]t is assumed that the second principal demand pressure for coal development will arise from the need to go beyond production for domestic consumption to the additional capability to export substantial quantities of petroleum products and feedstocks" (I-9). This sentence is incredible since it is clear that American oil production in the future cannot possibly meet American demands. We know of no plans for such exportation unless this is an allusion to the exportation of Alaskan oil and gas to Japan. However, throughout the debate on the Alaska pipeline bill, its supporters repeatedly denied that this exportation would occur. The statement should explain this pregnant remark.

Similarly, the statement says that "[I]t must also be assumed that any coal leases now or hereafter issued will be developed and coal produced" (I-10). However, as the Department well knows, despite diligence requirements in past leases, most federal coal leases have never produced any coal at all. Instead, coal leases have been obtained purely for purposes of speculation. Nonetheless, the statement merely assumes that production will occur without any discussion of the failure of this to happen in the past, the methods which will be adopted for ensuring it in future, or the techniques which will assure that regulations or lease provisions are actually enforced.

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ENVIRONMENTAL DAMAGE

Land Reclamation. One of the most vital topics in any environmental statement analyzing coal leasing is of course the possibility of rehabilitation. The statement recognizes this fact in saying that EMARS will only allow leasing "where effective rehabilitation can be assured" (I-3).

The statement admits (IV-29 to 30):

> There are many "unanswered questions — about revegetation in the far West — None of the (reclamation) projects has continued for an adequate time to demonstrate that the vegetation will be successful" (Council on Environmental Quality) (1973)

Subsequently, in considering "Adverse Environmental Impacts That Cannot Be Completely Mitigated," the statement includes the following remarks (V-1):

> Rehabilitation success varies with areas and climate. It may not be possible to immediately restore an area so it will grow the same type of crop. The soil productivity may also be lowered on some sites when profiles are altered. Larger tracts mined may contribute to greater economical efficiency in reclamation.

Later, the statements says (V-22):

> Whenever the natural interactions of parent material, vegetation, topography, and climate are disrupted by any action, the soils will be affected. Mitigating measures cannot immediately and completely restore soils to their former state. Soils may be stockpiled, moved and redistributed, but to some degree, the impacts will remain until the interactions again have time to reach equilibrium. The time required for equilibrium ranges from decades to a few hundred years in areas of high rainfall to many hundreds of years in arid climates, more particularly those with less than 10 inches of precipitation annually.
>
> Some properties of topsoils are not restored until equilibrium with the environment is reached. Nutrient recycling, profile development, and

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> organic matter cycling are examples of items not completely mitigable.

Similar statements appear at VII-2, VII-3, VII-5, VII-8.

Thus, the statement admits that strip mining involves a serious threat to land productivity. However, the analysis of this vital issue is far too general to be useful to any decision maker. While the Mitigation section describes generally certain reclamation techniques and cites studies which have used them (IV-28 to 47), an environmental statement is not intended to be a manual to be consulted by those proposing to strip mine land. Instead, the statement should evaluate, on the basis of the reclamation techniques available, what is the likelihood of success as to various conditions which are prevalent. While the statement does make a few general conclusions on this subject (IV-47 to 48), it does not show how these conclusions are based on particular studies demonstrating that successful results can be obtained. Moreover, the statement gives no consideration to studies, such as those cited in the Powder River statement, indicating that reclamation is extremely unlikely to be successful in arid and semi-arid areas of the West.

Without detailed analysis of the likelihood rehabilitation will be successful, it is impossible to decide intelligently any of the issues which are purportedly considered in this statement. It is impossible for the decision maker to decide, with reasonable consideration of environmental factors, to start a major coal leasing program without knowing specifically what the likelihood is that the land which will be lost cannot be restored to its present production and how much

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productivity is likely to be affected. Without detailed analysis of the different factors affecting rehabilitation, it is impossible to develop a rational system under EMARS for determining what land should be leased or mined. Without analyzing what rehabilitation methods work best depending on the particular kind of area involved, it is impossible to adopt regulations which will be effective in ensuring that reclamation will be successful.

The statements states, as we have noted above, that coal leasing will occur only "in areas where effective rehabilitation can be assured" (I-3). However, as we have also noted, the statement also admits that rehabilitation, at least in the West, cannot be assured. Moreover, the statement admits that "Federal coal reserves are primarily located in the West within the Rocky Mountains to Northern Great Plains Provinces" (I-7). Thus, if the statement is taken at face value, coal leasing can not be carried out on most federal coal lands.

The statement's views as to the doubtfulness of rehabilitation are stated even more forcefully in the draft Eastern Powder River Environmental Statement, which the Department of Interior released only shortly after this statement. That statement repeatedly admits that knowledge concerning reclamation after strip mining is scant; it is unknown whether it can be successful; and, even when it is, only about 50 percent of the prior productivity can be restored. See, e.g., id. at pp. IV-168, 172:

> It is estimated that total productive capacity of the land will be reduced 50 percent over present levels even if revegetation is successful.

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* * *

> It is doubtful that full production can ever be restored to areas severely disrupted by strip mining.

See also I-505,507,523,530,651.655,690,871; III-112,117,148,153 166-167,170; IV-115,156,169; V-101,116,140,143,148,160-161,164; VI-77,84,122,127,138-139,142; App. C-41 to 43. These conclusions, unlike those in the coal leasing statement, are based on analysis of studies of past rehabilitation efforts. Since rainfall in the Powder River Basin is equal to or greater than rainfall in most of the federal coal leasing areas in the West and since the availability of water is perhaps the most important factor preventing rehabilitation, these conclusions in the Powder River statement clearly apply to most, if not all, federal coal areas in the West.

Nevertheless, the coal leasing statement clearly assumes that federal coal leasing will be carried out in the West. It makes this assumption without any analysis of how reclamation can be assured. The statement should consider in detail this obvious and important inconsistency.

It is also important that the statement analyze the total damage which a federal coal leasing program will cause to the environment. In Natural Resources Defense Council v. Grant, 355 F. Supp. 280, 288-289 (E.D.N.C. 1973), the district court held that the environmental impact statement on the Chicod Creek Watershed Project must "consider fully * * * the cumulative impact of [that project] and other channelization projects on the environmental and economic resources of Eastern North Carolina"

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including the "cumulative effect of sedimentation" and the "cumulative impact of drainage projects upon hardwood timber or groundwater resources." The value of a programmatic statement, in contrast to statements on individual strip mines, is that it provides the opportunity for considering the total environmental impact of all similar federal actions.

Perhaps the most vital environmental issue in this country is to protect the land. More and more land is being taken away from agriculture at a time of growing world wide food shortages and increasing food prices even in this country and from recreational use when the demand for more open space is soaring. The statement should consider the total impact of federal leasing on land in this country and particularly in the West including the reduction in land available for agricultural production and recreation. This analysis should also consider other private and governmental actions which are likewise affecting land uses such as oil shale development, other kinds of mining, resort and second home development, and urbanization.

Wildlife. The statement says, with respect to wildlife in the Northern Great Plains Coal Province, that "/d/estruction of these habitats during surface mining and related operations without adequate reclamation might result in losses among these species" (III-62). It says that "/s/urface mining of coal causes extensive direct and indirect damage to wildlife" and that "/e/xtensive and long-lasting impacts on wildlife are caused by habitat impairment" (III-36, 37). Subsequently, the statement admits that "/t/he impact on wildlife from mine facility

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development cannot be mitigated in the immediate area of the facilities during the life of the mine" and that "/e/ffects on some species may be permanent, depending upon the type of rehabilitation employed and the land uses after mining" (V-18 to 19). The draft Eastern Powder River Environmental Statement makes these points even more strongly. For example, it states (III-117).

> No satisfactory evidence is presently available which would suggest that strip mined areas can be satisfactorily revegetated with plant communities that will satisfy the needs of deer and antelope.

See also I-530, IV-115, V-116, VI-84.

Thus, it is clear that strip mining will have a serious affect on wildlife. Yet, while listing numerous kinds of wildlife and including pictures of some of them, there is no analysis of just how serious the damage will be. The statement should consider what the total impact on wildlife will be from substantial federal coal leasing, together with other private and government actions and programs in these areas.

Water. The statement admits the possibility of serious damage to aquifers and surface water from strip mining. It describes, for example, deterioration in stream quality from toxic trace elements, high levels of dissolved solids, and increased sedimentation of as much as 1000 times former levels (III-33, 39, VI-6, VII-7). It admits that ground water supplies may be reduced in both quantity and quality by interference with aquifers (VII-33, 35, VI-6, VII-3). Nevertheless, the statement does not analyze the total effect on either the availability of water or the quality of water from a federal strip mining program.

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Damage from Other Coal Uses. The statement does not adequately discuss the use of coal from federal leases. It admits that "/n/either coal utilization nor the costs and benefits of coal mining technology are treated" (I-6). Despite this admission, the statement then claims that "/t/he impact * * * of mine-mouth electric generation plans is discussed * * *" (I-6). However, this discussion consists only of the most general listing of possible effects from such plants (III-69 to 73). There is no analysis of how such plants are likely to affect air quality, water quality, the availability of water or other elements of the environment. Moreover, the statement admits that "a detailed environmental analysis of the impact of coal conversion processes such as coal gasification is beyond the scope of this statement" (I-7).

Insofar as the statement does consider mine-mouth electric power plants, it describes a few devices which could reduce the environmental damage they cause (IV-69 to 70). In doing so, it erroneously states that "/t/echnology to remove 70% of SO_2 emissions is expected by 1977" (IV-69). In fact, technology, which will assure removal of 85 to 90 percent of sulfur-oxide emissions, is currently available. Environmental Protection Agency, National Hearings on Power Plant Compliance with Sulfur Oxide Air Pollution Regulations, pp. 3,27 (1974); Sulfur Oxide Control Technology Assessment Panel, Final Report on Projected Utilization of Stack Gas Cleaning Systems by Steam-Electric Plants (1973) (the Department of Interior was represented on this panel).

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It is impossible to consider the environmental effect of a federal coal leasing program without analyzing the affects on the environment of major projects which directly depend on federal coal leasing. Mine-mouth power plants, coal gasification plants, dams, reservoirs and water pipelines to supply water to these plants, and electric transmission lines and gas pipelines from the plants are often dependant upon the acquisition of federal coal leases on large areas of land. Thus, the impact of these projects is a direct result of the federal leases themselves. Unless these effects are considered, the full environmental effect of federal leasing has plainly not been discussed and the decision maker cannot determine whether large-scale federal leasing is beneficial.

Similarly, the statement does not consider the environmental injury which will be caused both inside and outside western coal areas by the transportation of western coal to the East and Midwest. For example, additional air pollution will be emitted throughout the railroad haul; slurry pipelines will consume water which is extremely scarce in western coal areas; new transportation facilities may be needed in other areas such as facilities for transfer of coal to water carriers; and dredging or other activities may be required in navigable rivers. It is essential that the total environmental impact of the proposed federal coal leasing be considered.

Moreover, analysis of the effects of using federal coal is necessary to determine whether federal policies or regulations should regulate the use of the coal extracted pursuant to federal leases and, if so, what these requirements should be. For

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example, Department of Interior leases might prohibit, generally, in particular areas, or on a lease-by-lease basis, mine-mouth power plants or gasification plants and require that coal be transported to the geographical area where it will be consumed so that the environmental damage will be increased, to the maximum extent possible, in the area of use. Alternatively, the regulations might impose special restrictions on power plants or gasification plants using federal coal which were designed to give additional environmental protection. For example, mine-mouth power plants might be required to be air-cooled in order to save water in semi-arid and arid regions and to utilize scrubbers to reduce sulfur oxide emissions regardless of the sulfur content of the coal.

Economic and Social Impacts. The statement describes only generally that serious economic and social impacts can result from strip mining and industrial uses of the coal (III-74 to 79). While the statement admits the possibility that "rates of delinquency, crime, personality disturbance, alcholism, alienation, and rootlessness may be increased" (V-7), these devastating consequences are not analyzed. Similarly, although the statement concedes the possibility that the residents will not benefit economically, it concludes that "/t/his is not necessarily valid, however, since the economy will probably not only flourish but boom" (V-7). Again, there is no analysis to show how residents will be affected by a booming economy and no consideration as to how long this boom will last and what will happen to the area when it is over.

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The statement's lack of analysis of this issue may reflect its conclusions in another part of the document that the economic and social impact will be entirely beneficial (V-4 to 5). It is said that tool will provide the strong tax base needed for a variety of services; ethnic people in mining communities will mix with the present residents and this "/c/ultural and ethnic mixing cannot help but produce the hybrid vigor we recognize as the distinct American culture"; permanent communities will result based on "/w/ell paid and well educated /employees who/ can build the kinds of communities they prefer, with all the advantages of similar communities elsewhere" These conclusions are obviously directly inconsistent with the statement's own earlier position. Moreover, they do not discuss the economic problems when a huge influx in population proceeds the increase in the tax base or which will occur when the easily accessible coal is exhausted in perhaps 30 years. They fail even to consider studies which have been made of the tension and social disorganization which results when newcomers with an entirely different culture numerically overwhelm existing residents in a short period of time.

In the Mitigation section, the statement considers only actions which could or should be taken (IV-5):

> The indirect and secondary impacts of resource development can be controlled or mitigated through regional and local planning and zoning. * * * Expanded services * * * must be well planned in advance of need.

The statement goes on to give advice on how the planning and services should be provided (IV-7 to 9). The statement, however,

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concludes that such planning is primarily a local responsibility and that the federal government's role is merely to encourage local planning and to provide grants (IV-5 to 6). There is little recognition that the statement is discussing problems which result from federal action in leasing large amounts of coal.

Instead of providing advice to others, the statement should consider federal actions which could assure effective planning and adequate services. For example, instead of merely saying that "financial participation by industry may be assential due to a previously limited tax base" (IV-6), the statement could consider requirements as part of federal leasing to assure this. Instead of saying only that "studies and research may be needed to supply missing information before further planning can take place" (IV-6), the statement could consider requirements that the mining companies provide this information, that the federal government itself do so, or that the federal government provide substantial funds to the States (as Montana has requested) for state studies. Instead of mentioning vaguely federal grants, the statement could consider special federal grants or loans, beyond these normally available to all communities, to sparsely settled areas without the financial resources to do the planning and provide the services before industrial expansion occurs.

Moreover, the statement assumes that coal development is good for local residents if they have adequate information (IV-7 - 8):

> A well-balanced public information effort in communities hearing social, economic, and political impacts due to boom psychology helps

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> to mitigate the effect by giving the people sound information on what to expect. * * * All manner of services * * * should be planned in advance of need to mitigate impacts and place emphasis on the more beneficial aspects of change.

In fact, however, the more information possessed by residents, the more they may oppose coal development because of the serious impact it will have on their economic well-being, the social structure of their communities, their environment, and indeed their whole way of life. While the statement can properly encourage the provision of information to residents as early as possible (indeed, the federal government has a responsibility to do so long before coal development), this information should be objective and should not be designed to persuade the residents that development is good for them. 5/

In short, the statement's analysis of environmental damage consists of lists of possible harm which could occur. Such general statements which do not show the extent and degree of the damage in specific terms cannot be used by a decision maker to determine if federal leasing is justified and, if so, on what basis it should occur.

5/ The statement's lack of sensitivity to the economic and social impact of coal development may result from its attitude toward the existing residents of western coal areas: "/T/his cultural framework for what it's worth will never be the same again" (V-8).

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GOVERNMENTAL REGULATION

While the statement describes generally federal and state laws and regulations relating to strip mining and the roles of the federal agencies involved (I-127 to 160), there is no analysis of their effectiveness. For example, the section on enforcement merely describes, in a cursory way, how enforcement is supposed to occur (I-156 to 159). In fact, enforcement of both federal and state law has been extremely ineffective. For example, the diligence requirements have been largely ignored and most federal coal leases have never been mined. Council on Economic Priorities, Leased and Lost, A Study of Public and Indian Coal Leasing in the West, p. 28 (1974). This same report shows that the Department of Interior has failed to enforce NEPA and other federal requirements as to coal leasing in the past. The General Accounting Office has issued two studies showing that the Department of Interior has not adequately enforced its own regulations relating to strip mining. GAO, Improvements Needed in Administration of Federal Coal Leasing Program (1972); GAO, Administration of Regulations for Surface Exploration, Mining and Reclamation of Public and Indian Coal Lands (1972). The statement contains no analysis as to whether rehabilitation has really occurred as a result of federal enforcement. It is obvious that the effectiveness of past enforcement of federal regulations and lease requirements is an important consideration in determining whether federal and state laws and regulations, regardless how strong they appear on paper, will really protect the environment. Yet, none of these problems is even mentioned.

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If a federal strip mine bill is passed in this session of Congress, the Statement should analyze in detail its affect on federal coal leasing. The bill may significantly affect the areas which are available to lease. For example, strip mining may be prohibited in alluvial bottoms. Indeed, the bill may prevent any strip mining in the West if it requires that the applicant show before leasing begins that rehabilitation will be successful. As we have seen, this statement and especially the draft Eastern Powder River Environmental Statement make clear that no such showing is now possible in arid and semi-arid regions of the West.

The statement further says that "/a/nalysis of legislative proposals concerning surface mining, land use planning, mineral development, energy research, utilization, transportation, etc. are largely beyond the scope of this statement" (I-8). There is no reason why this important topic should be excluded. Legislative proposals which have not yet been passed constitute important possible alternatives to present practices. Moreover, the National Environmental Policy Act specifically requires the preparation of environmental statements on legislative proposals made by the exective branch to Congress. Since none of the bills proposed by the executive in this field have ever been the subject of an environmental statement, it is appropriate that all reasonable proposals relating to coal leasing and mining be considered in this programmatic statement.

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ALTERNATIVES

The consideration of alternatives is perhaps the most important part of any environmental statement. The Guidelines of the Council on Environmental Quality provide (40 C.F.R. 1500.8(a)(4)), 38 Fed. Reg. 20554):

> A rigorous exploration and objective evaluation of the environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects, is essential. Sufficient analysis of such alternatives and their environmental costs and risks shall accompany the proposed action through the agency review process in order not to foreclose prematurely options which might enhance environmental quality or have less detrimental effects.

In Calvert Cliffs' Coordinating Committee v. AEC, 449 F.2d 1109, 1128 (1971), the Court of Appeals for the District of Columbia Circuit emphatically said:

> By now, the applicable principle should be absolutely clear. NEPA requires that an agency must -- to the fullest extent possible under its other statutory obligations -- consider alternatives to its actions which would reduce environmental damage. /emphasis in original/

The importance of considering alternatives was made especially clear by Congress by adopting Section 102(2)(D), 42 U.S.C. 4332(2)(D), in addition to Section 102(2)(C)(iii). Section 102(2)(D) requires "all agencies of the Federal Government * * * /t/o study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning uses of available resources." This provision applies, as its lan-

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guage makes clear, independently of Section 102(2)(C)(iii). 40 C.F.R. 1500.6(c), 38 Fed. Reg. 20551; Hanly v. Kleindienst, 471 F.2d 823, 835 (C.A. 2, 1972), certiorari denied, 412 U.S. 908, (1973). The Court of Appeals for the Second Circuit held in Monroe County Conservation Council, Inc. v. Volpe, 472 F.2d 692, 697-698 (1972), that:

> The requirements of a thorough study and a detailed description of alternatives, which was given further Congressional emphasis in /Section/4332(2)(D) is the linchpin of the entire impact statement.

Similarly, in EDF v. Corps of Engineers, 470 F.2d 289, 296 (C.A. 8, 1972), the court of appeals held that a "more extensive treatment of alternatives /i/s required by §102(2)(D)" than by Section 102(2)(C) for environmental statements. And the court of appeals held in Calvert Cliffs Coordinating Committee, Inc. v. AEC, supra, 449 F.2d at 1114, that:

> Section 102(2)(D) requires all agencies specifically to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." This requirement seeks to ensure that each agency decision maker has before him and takes into proper account all possible approaches to a particular project (including total abandonment of the project) which would alter the environmental impact and the cost-benefit balance. Only in that fashion is it likely that the most intelligent, optimally beneficial decision will ultimately be made.

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The alternative section of this statement is extremely lengthy (VIII-1 to 137). Of the 137 pages, however, only 10 pages relate to other alternatives for the mining of coal. All the other pages are essentially the same material which is being repeated in environmental statement after environmental statement concerning entirely different sources of energy and energy conservation. While these materials should be included, it is equally and probably more important to analyze in detail the more closely related alternatives to the coal leasing program which could far more easily be adopted. Thus, these realistic alternatives involving different sources of coal, different techniques to obtain it, and different regulations to govern it require substantial expansion.

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The inadequate consideration of meaningful alternatives may be the result of grossly mistaking the question to be considered. The statement says that "[t]he major environmental issue is whether or not an orderly system of lease allocation and potential subsequent development is environmentally superior to unregulated leasing" (V-1). If unregulated leasing were the alternative, it would take little analysis to decide which course should be taken. However, the real alternatives are entirely different. They include whether the federal government should mine western coal for strip mining and, if so, how should this be done and how should it be regulated to minimize environmental damage.

Non-Federal Sources of Coal. The statement says that "[I]f this mix [of energy sources] were altered by the elimination of the Federal coal leasing program, this report finds no measures available which could stimulate an equivalent production potential of alternative energy sources * * * " (VIII-1). However, the most obvious alternative source is hardly considered — coal which is on private, State, and Indian lands. Vast amounts of non-federal coal is available throughout the country.

The statement argues as a reason for federal leasing that "[I]t is widely felt that the Federal Government is more diligent in enforcing environmental safeguards" (VIII-130). It is not clear whether the statement is comparing the federal government to private land owners or to the States. It is of course the States who regulate such mining and, if a federal strip mining bill is passed, the federal government will also do so. It is not clear that State and

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perhaps federal regulation of strip mining on private lands will be less effective than the federal government's regulations concerning the strip mining of federal coal. As we have noted, the Department of Interior has not adequately enforced its own regulations. In any event, this is an important subject worth considerable analysis.

The statement also says that if the federal government does not lease more coal, there will be increased pressure on other lands and "many of these sites or locales lack superior suitability" (VIII-130). While this is doubtlessly true, many federal lands also lack suitability. The issue is whether there will be effective government regulations to prevent the mining of unsuitable lands, whether federal or non-federal. If the federal strip mining bill passes, the same requirements will apply to all lands. Even if it does not pass, it is not clear, as noted above, that state regulations are generally less effective than federal regulations have been in the past. Moreover, the statement does not include any specific criteria concerning what federal coal will be leased providing any assurance that unsuitable federal lands will be protected.

The statement argues that federal coal should be leased because its "abundance and accessibility * * * makes it an important fuel reserve for national security" (VI-3). It is said that strip mines can become operational more quickly. However, if this is true, then this coal should be held in reserve until a time of national emergency. It makes no sense to exhaust during peacetime all our readily accessible coal leaving only underground coal which would take considerable time to develop. The Department of Interior's Coal Extraction Task Force found that the exhaustion of western

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strippable coal was a real possibility by the end of the century. This issue of national security at least deserves more than an unsupported and implausible conclusion.

Eastern and Midwestern Coal. The statement fails to analyze whether sufficient coal is available in the East and Middle West without exploration of western coal.

First, based on the Btu content of the coal, "almost 55% of the total reserve is east of the Mississippi." Environmental Policy Center, Facts about Coal in the United States, p. 1 (1974). Yet, the statement does not consider coal reserves except those belonging to the federal government.

Second, there are sufficient quantities of low sulfur coal in the East and Middle West. Studies have shown that "low sulfur coal in the Central Appalachian States has four times the energy potential of the reported strippable coal in the Northern Great Plains and New Mexico." Id., p. 9. Although the statement admits that "good-sized reserves of low and medium sulfur coal are reported in the east" (I-52), no figures are provided even though specific government data is readily available. See Environmental Policy Center, supra, p. 7.

The statement, on the other hand, assumes that federal coal in the West is low in sulfur content (e.g., I-37, 44, VI-2). While the sulfur content of various kinds of coal is described, this is never done with reference to its Btu content (see I-43 to 44). In fact, when classified on the basis of sulfur per Btu much of western coal is not low sulfur at all. Environmental Policy Center, supra, pp. 8-9.

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Third, the statement does not adequately discuss the serious deficiencies in the quality of western coal reserves. Those reserves consist of sub-bituminous coal and lignite which are capable of producing only relatively low amounts of heat (expressed in Btu's per pound) by comparison with the high Btu value of bituminous coal that can be extracted from other American sources chiefly in central Appalachia. Id., pp. 1, 7.

Fourth, the statement suggests that the coal subject to existing federal leases may not be available as a practical matter because of its geographical inaccessibility (I-200 to 201). However, it does not apply this same analysis to federal coal which has not been leased. Thus, the statement does not analyze the cost of transporting coal from western strip mines when delivered to the Middle West and East.

In fact, it appears that western coal is substantially higher in price than Midwestern and Eastern coal on the basis of cost per Btu when delivered to the East and Midwest. Environmental Policy Center, supra, p. 18. The statement, however, says, without analysis or explanation, that "Federal coal in Wyoming and Montana, for example, is competitive with locally produced private coal in the Midwest for use in population centers and Chicago and St. Louis" (VI-2 to 3). This question, concerning the price of western coal to consumers, requires detailed consideration.

Fifth, at a time when the United States is particularly concerned with reducing energy waste, the statement does not consider the loss of energy from the use of the large quantities of diesel fuel by the unit trains or the loss of electricity from transmission

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lines that will transport coal and electricity from the West to points half way across the country. Fair analysis requires the deduction of the energy consumed in this transportation from the energy produced by the coal which is transported in order to obtain the net energy produced. There are serious environmental and economic questions presented by this waste as compared to the option of expanding utilization of coal reserves located closer to energy users in the East.

Sixth, there is no consideration of the effect on Appalachia and other economically depressed coal areas in the East and Midwest from the expansion of coal production in the West. Western coal development could result in additional unemployment in the East and Midwest or prevent, at the least, an increase in employment in areas of present high unemployment. Similarly, there is no consideration of the effect western coal development will have on eastern railroads which are already financially depressed.

Strangely, the statement says that if western federal coal is not leased, "a major adverse impact would be felt by the segment of the public who are dependent either directly or indirectly on the program for their economic livelihood. While the possibility exists for some shifts of the labor force, * * * it can be expected that the net impact would be to increase unemployment * * * " (VIII-1 to 2). This conclusion is totally unexplained. It is clear that major federal leasing is not needed to prevent unemployment or any other significant economic affects in the West. The fact is that little coal is now being mined on federal leases. A relatively few leases would be sufficient to sustain existing mines when they are

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close to running out of available coal and if State or private coal was not available. Such leasing is now provided for even under the Department of Interior's moratorium on coal leasing without any new major federal coal leasing program. In any event, if the alleged need to develop western coal to protect the economy of western coal areas is to be considered as supporting major federal coal leasing, the statement should at least consider the adverse economic effects from such a program on other parts of the country.

Seventh, the statement does not discuss why utilities are seeking to use western coal, despite its low quality, higher costs and the availability of eastern low sulfur coal. It appears that the reasons for this shift include the ease of obtaining large blocks of coal reserves by leasing coal lands from the federal government and Indian tribes, the desire to avoid contracts with union coal miners, the less stringent reclamation laws and lower royalty payments for coal extracted from Indian lands, and the "fuel adjustment clause" in electric-rate structures which enable utilities to pass through to customers all of their increased costs for western coal at a substantial profit and without rate-increase hearings before state utility commissions. Environmental Policy Center, supra, pp. 14-15.

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Eighth, development of the Basin's coal reserves raises a serious problem with regard to utilization of stack-gas cleaning equipment in order to meet national air-quality standards. It has been shown that utilities in the East and Midwest could save money by using eastern coal, whatever its sulfur level, and installing sulfur-dioxide removal equipment on their stacks in order to meet air-quality standards. Id., pp. 15-16. However, utilities are ignoring the economic benefits from the use of eastern coal and instead are relying heavily on low sulfur western coal in order to avoid installation of this stack-gas cleaning equipment. The environmental implications of the utilities' actions have been pointed out by a federal inter-agency task force (Final Report, Sulfur Oxide Control Technology Assessment Panel, Projected Utilization of Stack Gas Cleaning Systems by Electric Plants, pp. 68-69 (1973):

> The two low sulfur fuel alternatives [oil and coal] do appear more attractive to many utilities because they involve only small capital investments and shift the environmental protection strategy to an operating cost. In a number of states, utilities are now able to pass on to the consumer most of the incremental operating costs of higher-priced fuels by means of "fuel adjustment" provisions. The fuel adjustment charges may be passed directly to the consumer via the monthly bill without further action by the regulatory commission. On the other hand, increases in generating costs due to carrying charges on or operating costs of capital equipment can be compensated only by rate increases which require commission action. Not only do the utilities claim that they must wait for this compensation until the regulatory commissions act but also they claim that they often have to "absorb" some of the additional costs, particularly from non-productive equipment such as pollution abatement devices. This situation tends to force utilities to secure as much low sulfur fuel as is available and then wait to see what the Environmental Protection Agency or state agencies will do to enforce the standards. * * *

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> While the probable dislocations in fuel supply resulting from these factors raise many questions, one of the most disturbing is the precipitous rush by the utilities to obtain low sulfur coal contracts and thus to show "good faith" in compliance insofar as the low sulfur coal is available. Vigorous utility competition for low sulfur coal from new and proposed mines in Wyoming and Montana has led to widespread speculation in land and water rights, particularly in the Powder River Basin. Much of the coal in this region lies under land whose surface rights are privately owned but whose mineral rights are either owned by the Federal government or Indian tribes. Few mines are operating today but many applications for leasing public mineral rights are pending and blocks of coal deposits owned by the railroad and other private interests, the states, and Indian tribes (off the reservations) are being unitized for exploitation. Acceptable reclamation of these semi-arid lands has yet to be demonstrated. The sudden surge for development of these resources finds both states and the responsible Federal agencies inadequately prepared to cope with the array of immediate problems presented by the development let alone long-range cumulative effects on the economic, physical, and social environment of the region. Since stack gas cleaning represents a technological alternative in the near-term to such a culture-and environment-shattering resource development, the full implications of both options should be explored.

This issue is not considered in the statement.

In short, eastern and mid-western coal appears to be a feasible alternative to federal coal leasing in the West. It appears that western coal is being sought by private companies to maximize their own profits rather than because other coal is unavailable, or costs will be lower for consumers, or the environment will be better protected. At the very least, these issues deserve careful analysis.

Underground Mining. The statement's comparison of underground and surface mining is grossly inadequate. For example, the statement says: "No technology exists for underground mining of thick coal seams common to the West, especially under shallow

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overburden" (I-116). In contrast, the draft Eastern Powder River Environmental Statement admits that underground mining is feasible: "The immense coal reserves and resources of the Eastern Powder River Basin are amenable to mining by both open cast and underground methods" (I-22). Moreover, the coal leasing statement does not mention that some coal is now deep-mined in the West, that vast quantities of western coal exist which have sufficient overburden to allow underground mining, what possible technologies may become available to deep mine western coal, or what quantity of western coal can be deep mined using present technology.

Moreover, the statement does not consider the problem which may result when strip mining occurs first.[6/] Such strip mining, by removing a substantial amount of coal and overburden, may result in preventing the deep mining of coal which now lies under sufficient coal and overburden to be deep mined. Thus, the surface mining of coal before strip mining can prevent the recovery of substantial amounts of coal.

Subsequently, in discussing the alternative of deep mining (this obvious major alternative is discussed in less than two pages (VIII-132 to 133)), the statement says that "[s]ubsidence cannot be properly controlled in shallow deposits" (VIII-133). No consideration is given to huge amounts of deeper western coal. The statement goes on to say that "[c]ontinued movement and collapse of the surface in random patterns and over many years can easily cause more disruption for a longer

6/ The statement does no more than recognize the need "[t]o preserve the coal underground but too deep for further surface mining," presumably so that it can later be mined (V-54).

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period than a properly managed and rehabilitated surface mining operation" (VIII-133). The statement thus says that a poorly managed underground mine is worse than a well-managed surface mine if the surface mine has been able to reclaim the land successfully. Of course the question, which is merely assumed in the statement, is whether rehabilitation can actually be attained on most western land.

Finally, the statement admits that "it can be stated that underground mining results in less natural resource impact than strip mining" (VIII-133). However, again without analysis, the statement dismisses this important conclusion by saying that "[u]nfortunately, underground operations are hazardous to the people who must work in them" (VIII-133). While this is doubtless true, there is no comparison with the dangers of strip mining. Recent statistics released by the Mining Enforcement and Safety Administration suggest that strip mining may be equally or more dangerous since strip mining deaths from January to August 1974 were 50 percent higher per man hour worked.[7/] Moreover, there is no consideration of recent improvements in federal safety regulations in underground mines or possible technological advances relating to safety in the future. In any event, this issue, as well as the environmental effect, should be considered in detail.

The statements lack of alternatives to underground coal may be the result of its conclusion that most federal coal "is

7/ The record of the U.S. Steel in running underground mines more safety than any other underground or strip mines in the country for the last five years also suggests that underground can be at least as safe as surface mining.

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recoverable by surface-mining methods" and that "most federal coal can be mined by surface methods" (VI-2, 3). This statement is simply untrue. Most western coal can only be deep mined. If this error were rectified, a full consideration of the importance and feasibility of underground mining should result.

Existing Federal Leases. The statement inadequately evaluates the amount of coal already subject to federal leases and prospecting permits. While huge amounts of coal subject to the leases and permits are described (I-196, 198),[8/] these figures are then belittled. It is said that much of this coal is already committed for various purposes (I-199). Even though this is so, these commitments are presumably for energy needs and therefore relieve the need for other energy supplies just as much as if the coal was not committed. Moreover, the statement does not even provide the amount of such commitments as to federal coal (I-199). Finally, the commitments are clearly overemphasized. Given the long lead time for coal-gasification plants, which the statement says is 10 years (I-202), it is simply inconceivable that 36 such plants will be in operation by 1985 (see I-199) when no such plants are even under construction, the technology is not well developed, and many western states are strongly opposing the use of water for this purpose.

The statement also suggests that the federal coal which has already been leased is not sufficient because of the geographical location of much of this coal and the transportation

8/ See also the statistics in S. Rep. No. 984, 93d Cong., 2d Sess. 6,8 (1974).

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cost to get it to market (I-200 to 201). However, the coal which will be leased under any federal coal-leasing program will almost entirely be equally distant from the population centers of the country. There is certainly no reason to lease more western coal because the present leases are in the West.

The statement concludes that "[t]here is probably not enough Federal coal to meet the nation's needs without additional Federal leasing" (I-202). The tentativeness of this conclusion on such a vital subject is striking. The statement should analyze this question in detail.

Even if it is decided that more federal coal should be leased, the statement should consider the amount and rate of leasing which is required. The question is not simply to lease or not lease — the amount of leasing is also important to determine the amount of environmental harm which will result. Similarly, the statement should describe specific criteria which will be considered to determine the geographical areas where leasing will be done.

Cancellation of Federal Leases. The statement says that "[l]arge areas have already been leased without regard to the kinds of consideration now generally agreed as being essential" (I-11). Assistant Secretary Hughes' memorandum admits that the statement "has not sufficiently analyzed * * * possible limitations on development of leases which now look environmentally unacceptable * * *." Indeed the statement, while mentioning the possibility that existing coal leases could be cancelled for environmental reasons (VIII-136), remarks that "[c]oal will

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probably be mined from those Federal lands where mineral rights have already been leased regardless of whether or not the proposed EMARS is adopted" (VI-1). Having already come to this conclusion, it is not surprising that the statement provides no analysis of the alternative of cancelling the leases. The statement should provide details concerning these leases, the kinds of environmental damage which are likely, and an estimate of the number of acres which should not, on the basis of environmental considerations, be mined.

Moreover, the statement suggests that cancellation would require "ample funding" from Congress. No consideration is given to the possibility that many of the leases are invalid. The statement should discuss whether the leases can be cancelled for such reasons as the failure to prepare environmental impact statements before the leases were entered into (this includes all leases entered into during or after 1970), the failure to comply with diligence requirements, and the issuance of leases based on preference permits which were invalid because the presence of coal deposits was already known at the time.

Similarly, consideration should be given to whether existing leases must be issued to holders of preference-right permits. A huge amount of acreage is now subject to such permits and many of the permit holders have applied for preference-right leases. The statement should discuss whether the Secretary can refuse to issue such leases either because there are already sufficient federal leases, because the particular conditions in the area make rehabilitation unlikely, or because other environmental damage will result.

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Federal Exploration. The statement provides, in half a page, totally inadequate analysis of federal development of coal either generally or on a limited basis (see VIII-137). The federal government might for example, stop further leasing until it had developed strip mines in areas with difficult climatic and other conditions and had evaluated the success of various rehabilitation techniques. The statement does not analyze whether or not federal development would result in better environmental protection.

Criteria for Mining. The statement suggests that (IV-52):

> If coal must be mined, it should first be done in areas of least rather than most value for a given use. If a choice can be made, it should first be done on areas with values less necessary to society than others.
>
> Stated in reverse, for example, grazing land should be mined before land producing truck crops. The poorest of the grazing land should be mined first * * *. If the poorest grazing land has a high scenic value, the latter may than dominate judgments.

While this conclusion superficially appears reasonable, it ignores the fact that areas of so-called lesser use will also be more difficult to rehabilitate. Thus, "[t]he poorest grazing land" will usually be land with less rainfall and poorer soil. Consequently, the permanent damage to land may actually be greater for "poorer" lands which cannot be rehabilitated in comparison to better land which might fully be restored.

Moreover, the statement should consider the effect of designating large areas of the West as "national sacrifice" areas to supply energy to other parts of the country. While such areas may not be considered scenic or beautiful to some

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eastern eyes, residents and many other people believe that these vast open spaces have a beauty and grandeur which is extraordinary.

More Effective Regulations and Enforcement. The statement should consider more effective regulations and methods of enforcement to prevent environmental damage. As we have noted, no alternatives to the proposed regulations printed in the appendix are even suggested.

The Mitigation section is filled with statements about what should and can be done to reduce the environmental harm from strip mining: "Impacts on topography should be mitigated to the extent necessary to mitigate impacts on hydrology, soils, vegetation, wildlife, ultimate land uses and aesthetics"; "Revegetation should follow mining as quickly as possible"; "Waste piles, coal storage piles and settling ponds must be located so that they can't be washed away"; "Consumption of water resources can be partially mitigated by using dry cooling towers" (IV-25, 27, 71). Such remarks do not constitute mitigation measures which will in fact be taken. No indication is given whether the mitigation measures have to be taken or, if not, even whether they are likely to be adopted voluntarily. The statement should describe how the various mitigation techniques will be required and how such requirements will be effectively enforced.

For example, the statement should consider what regulations and lease forms should be used to ensure that the applicant demonstrate before leasing or, at least before mining, that reclamation can actually be successful. The proposed

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regulations contain no such requirement. This should include specification as to what data is required to be submitted by the coal companies in order to show that rehabilitation can be successful based on the particular rainfall, weather, soil, and other conditions involved. Such a requirement will remedy the present situation where the company simply describes what rehabilitation techniques it will follow without providing any basis for believing that these techniques will be successful.

The statement should also consider modifications in the standard federal coal lease. The standard lease, which is merely described in the statement (IV-13 to 14), is extremely general in its provisions relating to protection of the environment. Specific provisions are necessary if they are to be effectively enforced.

The Department of Interior has recognized the need to study its regulations and enforcement. Under Secretary Whitaker's memorandum entitled "Coal Leasing Program" (May 7, 1974) directs that studies be begun concerning improving enforcement, new provisions in the lease form, EMAR procedures, and other regulatory issues. These studies should be used to provide analysis of various regulatory alternatives in the statement.

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CONCLUSION

We have shown that the draft statement is grossly inadequate. These deficiencies, as the Department of Interior has admitted in Assistant Secretary Hughes' memorandum, are not similar to the deficiencies which appear in many draft environmental statements and which can be remedied in the final statement. The Secretary has admitted that there will have to be "major revisions of the Statement" and "we cannot simply touch up the draft in this case." This statement is so deficient that it cannot be adequately analyzed either by other government agencies or the public. It therefore cannot meet the purpose of draft environmental impact statements as set forth in the Guidelines of the Council on Environmental Quality. We request that a new draft environmental statement be prepared whenever the Department of Interior has a specific federal program which it is considering with regard to coal leasing.

Secretary Hughes stated in his memorandum:

> I am afraid that the weakness of this draft reflects the general state of our development of the new coal program. I am asking my staff to review this with GS and BLM, and to make recommendations on what we need to do over the next six months or so in order to move the coal decision process along in an orderly way.

Subsequently, on May 16, 1974, Undersecretary Whitaker issued a memorandum describing ten background studies which would be carried out concerning various aspects of the coal leasing program. Thus, it appears that the Department will be reformu-

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lating its entire coal leasing program because of its present inadequacy as to which this statement is merely a symptom. When the program is reformulated and specific actions can be proposed, a new draft statement should be issued to allow full participation of other government agencies and the public. In this manner, a sound leasing program can result which will fully protect the environment and meet the requirements of the National Environmental Policy Act.

Appendixes

Appendix A
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Appendix B
Glossary

Albedo – Ratio of the light falling on a planet or satellite to that which is reflected.

Alkali Soil – A soil that contains sufficient sodium carbonate or other alkali salt to give it a pH of 8.5 or higher.

Available Water Capacity – Available water capacity refers to the total quantity of water available for plant growth that is stored in the effective root zone or the upper 60 inches of the soil profile at field capacity. It is largely dependent upon the effective depth, texture, structure, porosity, organic matter content, and coarse fragment content. In general, profiles that contain 50 percent coarse fragment by volume will only have one-half the moisture holding capacity of a comparable soil that is free of coarse fragments.

Coke – A combustible material consisting of the fused ash and fixed carbon of bituminous coal, produced by driving off by heat the coal's volatile matter. It is grey, hard and porous. Used in blast furnaces, as a fuel in the steel making process.

Coking Coal – A bituminous coal suitable for the production of coke.

Coking Characteristics – A bituminous coal that can be coked. Often blended with coking coal.

Dip – The angle that bedding plane or coal bed makes with the horizontal, measured perpendicular to the strike of the bed.

Fault – A surface or zone of rock fracture along which there has been displacement, from a few inches to, in some instances, miles.

Gasification – The changing of a solid or liquid into a gas without leaving a combustible residue. In gasification of coal, a series of reactions produce a gas that can be substituted for natural gas in most uses.

Gob – Soil material or disposed piles associated with underground or surface mining usually collected in a specified area and periodically disposed of in the worked out mine areas.

Highwall – The unexcavated face of exposed overburden and coal in a surface mine.

Hydrologic Groups – Soils are placed in hydrologic groups according to their potential to yield run-off. This information is used in watershed planning. Various hydrologic groups range from (A), that shed almost no precipitation to (D), that shed nearly all the precipitation.

The four hydrologic groups are defined as follows:

A. Very deep, coarse and moderately coarse textured soils that transmit water through their profile and substratum at a high rate. These soils have the lowest run-off potential.

B. Medium to fine-textured, moderately deep to very deep soils having a moderate rate of water transmission through the profile.

C. Fine-textured, deep and very deep soils that have a slow rate of water transmission through the subsoil.

D. Fine-textured, deep soils, and impervious material exposed or covered by a thin mantle of soil. These soils have the highest run-off potential.

Hydrologic Soil Group Condition – Condition of soils within groups relating to their capacity to produce runoff as governed by their cover of plants, litter, etc. Poor condition has less than 30% cover, fair, 30-70% and good more than 70%.

Lenticular – Resembling a lens in shape, thick in the middle, and thinning out toward the edges.

Metallurgical Grade – Having qualities that meet specifications for special uses. Coal that is low in sulphur, phosphorous and has coking qualities.

Outcrop – That part of a geological formation, a coal bed that appears at the surface of the earth.

Overburden – The rock, soil, etc. covering a seam of coal to be surface mined.

Props or Mine Props – Timer or steel supports for the roof. Steel props may be of the yieldable type.

Relief – Relief is expressed as a range in the slope percentage that each soil may have.

Shuttle Car – A vehicle propelled by electric motors receiving its energy through a portable cable. Its function is to transfer coal from loading machines in truckless areas of a mine to the main transportation system.

Soil Name – Each soil series in the United States is given a name. The name identifies a specific soil just as names identify people. Soil names are correlated so that any one name applies only to a specific soil, regardless of occurrence.

Spoil – The rock, soil, etc., of the overburden after it has been broken and removed from above the coal seam.

Strike – The course or bearing of the outcrop of an inclined bed or structure on a level surface; the direction or bearing of a horizontal line in the plane of an inclined stratum, joint, fault, cleavage plane, or other structural plane; it is perpendicular to the direction of the dip.

Syncline – A fold that forms a trough. The same beds often outcrop on

both sides, whereas in the center, they are deeply buried.

Tipple – Originally the place where mine cars were tipped and emptied of their coal. Now it is generally applied to the surface structure of a mine, housing the coal breaker, screens, loading facilities and preparation plant.

Unified Classification – This is one of the two systems that classify soil material for engineering uses.

The Unified soil classification system identifies soils according to their textural and plasticity qualities, and their grouping with respect to their performance as engineering construction materials. Soil materials are divided into 15 classes; eight classes are for coarse-grained material, six classes are for fine-grained material, and one class is for highly organic material. Soils that have characteristics of two classes are designed by symbols for both classes; for example, CL or ML. Each class is identified by a letter symbol. GP identifies poorly graded gravel and mixtures of gravel and sand with little or no fines. Soils in class SM are silty sands and mixtures of sand and silt. Soils in class ML are inorganic silts of low liquid limit that are mixed with sand and clay. Soils that are predominantly silts and clays have a low liquid limit are in class CL. The symbol CH identifies inorganic clays that have a high liquid limit and plasticity.

The first letter of the class symbol indicates the grain size, for example, G stands for gravel, S for sand, C for clay, and O for organic. The modifying terms indicated by the second letter are P for poorly graded, W for well graded, M for silty, and C for clayey. The symbol L stands for low liquid limit and H for high liquid limit.

Appendix C Endangered Species Which May Occur On Federal Coal Lands

Endangered Species	Pacific Coast Coal Province	Rocky Mountain Coal Province	Northern Great Plains Coal Province	Interior Coal Province	Gulf Coal Province	Eastern Coal Province
Aleutian Canada goose	X					
American peregrine falcon	X	X	X			
Arctic peregrine falcon	X					
Columbian white-tailed deer	X					
California brown pelican	X					
Unarmored threespine stickleback	X					
Blunt-nosed leopard lizard	X					
Southern bald eagle	X	X	X		X	X
San Joaquin kit fox	X					
Black-footed ferret		X	X	X		
Humpback chub		X				
Kendall Warm Springs dace		X				
Colorado River squawfish		X				
Greenback cutthroat trout			X			
Woundfin		X				
Gila trout		X				
Mexican duck		X				
Arizona (Apache) trout		X				
Indiana bat				X		
Kirtland's warbler				X		
Clear Creek gambusia					X	
Fountain darter					X	
American alligator					X	
Texas blind salamander					X	
Houston toad					X	
Attwater's greater prairie chicken					X	
Whooping crane					X	
American ivory-billed woodpecker					X	
Red wolf					X	
Bachman's warbler					X	X

Appendix D
U.S. Forest Service Selected Manual Instructions And Forms Pertaining To Coal Leasing

MINERAL LEASES AND PERMITS ISSUED BY BUREAU OF LAND MANAGEMENT ON LANDS RESERVED FROM PUBLIC DOMAIN

The Secretary of the Interior may issue mineral leases for coal, phosphate, sodium, potassium, oil, oil shale, or gas, and in Louisiana and New Mexico sulpher, on national forest, Title III, and other lands of the United States reserved from the public domain and administered by the Secretary of Agriculture except as specified below. Prospecting permits may be issued for each of the above minerals except phosphates, oil and gas, and oil shale. The authority to issue is discretionary but once a prospecting permit or lease has been issued, the permittee or lessee obtains specific rights. These rights may be terminated only as provided by law or regulation. The Mineral Leasing Act of February 25, 1920, as amended and supplemented, is the leasing authority for these minerals occurring in public lands (30 U.S.C. 181, et seq.).

Reference to Forest Service and Action on Forest Service Recommendation

All applications or offers to lease mineral deposits in lands under the jurisdiction of the Forest Service are referred to the Forest Service for report and recommendation. This requirement, made under letters of agreement between the Secretaries of the two departments, is embodied in the BLM Minerals Manual (instructions to the field). Reference is direct from the land office to the appropriate regional forester.

The standard Stipulation for Lands Under Jurisdiction of Department of Agriculture, Form BLM 4-216 (August 1952) (FSH 2824.42), will be made a part of each permit, lease, or license issued for land under Forest Service jurisdiction. Additional conditions to protect the land will be imposed as deemed necessary and requested by the Forest Service (43 CFR, 1958 Supp., 191.6).

Coal

Known deposits shall be leased by the Secretary of the Interior "by competitive bidding or by such other methods as he may by general regulations adopt. . . ." The regulations of the Secretary of the Interior require competitive bidding except when (1) prospecting is necessary to determine the existence or workability of the coal deposits, (2) applications are filed by individuals or municipalities for coal for local domestic use, and (3) additional acreage is necessary to permit a person, association, or corporation already holding an aggregate of 10,240 acres under lease or permit to carry on business economically and is in the public interest (FSH 2824.25).

Technical Supervision

The Geological Survey is responsible for the technical supervision of all permits and leases under the act.

Extent and Existence of Deposit

The Geological Survey advises BLM whether further prospecting or exploratory work is necessary to establish the existence or workability of deposits of coal, or whether additional area is necessary to permit an economic business operation (FSM 2824.25).

Delegation from Chief

Authority is delegated to the regional foresters to make reports on applications for permits, licenses, or leases under the 1920 act directed to the manager of the local land office except in those cases where removal of the resources by stripping, contour, or open-cut or pit mining is contemplated or anticipated, and the area exceeds 40 acres in all.

Impact Analysis

Application for a mineral permit or lease will be given the same consideration as any other land use. An analysis will be made of the possible and probable effects that prospecting or mining will have on other land management functions. Factors to be considered will include:

a. Uses, existing or planned.
b. Dedications or withdrawals.
c. Protection or utilization of other resources.
d. Damage to watersheds.
e. Polution of water resources.
f. Scarring and erosion of land.

g. Surface disturbance, restoration, and rehabilitation.
h. Economic aspects.
i. Nature and extent of mining operations, above or below ground; plants, roads, pipelines, other auxiliary uses.
j. Term of permit or lease, extension.
k. Over-all land classification or future land-use plan.

Except for those areas, uses, or purposes where mining cannot be permitted without destroying the value, use, or purpose for which set aside, used, or dedicated, all values will be considered. Areas reserved for future use will be treated in the same manner. There will normally be no objection to mining which can be carried on in conjunction with other land uses and with a minimum of damage to resources. Also, the Forest Service normally will not object to prospecting or mining where the mineral values are known to exceed other values or where the minerals are needed for defense purposes. In such cases, national forest interests will be protected to the maximum degree possible.

Appendix E

Proposed Prototype Surface Management — Environmental Coal Lease Stipulations Based On Stipulations Developed For Oil Shale Surface Mining

SECTION 1
GENERAL

A. Applicability of Stipulations

The terms, conditions, requirements and prohibitions imposed upon the Lessee by these Stipulations are also imposed upon Lessee's agents, employees, contractors, and sub-contractors, and their employees. Failure or refusal of Lessee's agents, employees, contractors, sub-contractors, or their employees to comply with these Stipulations shall be deemed to be the failure or refusal of the Lessee. The Lessee shall require its agents, contractors, and sub-contractors to include these Stipulations in all contracts and sub-contracts which are entered into by any of them, together with a provision that the other contracting party, and its agents, employees, contractors and sub-contractors, and the employees of each of them, shall likewise be bound to comply with these Stipulations.

B. Changes in Conditions

These Stipulations are based on existing knowledge and technology. They may be revised or amended, in writing, by the mutual consent of the Mining Supervisor, the Bureau District Manager, and the Lessee at any time to adjust to changed conditions or to correct an oversight. The Lessor may amend these Stipulations at any time without the consent of the Lessee in order to make these Stipulations consistent with any new Federal or State statutes for the issued under those statutes. The Lessee, the Mining Supervisor, and the Bureau District Manager shall meet at least once a year to review advances in technology and, in a mutual endeavor, weigh, and decide the feasibility and need of revising or amending existing Stipulations.

The Lessor and the Lessee agree that, in this mutual endeavor to decide upon the feasibility and need for amending the existing Stipulations, they will act in good faith and in a sincere effort to make the Lessee's activities under the lease as free from environmental damage as is practicable. Toward this end, systems which require pollution control devices shall possess sufficient flexibility to adopt improved technology when the improvements are available, and the systems shall be constructed with the understanding that continued compliance with changing pollution control laws is required.

C. Emergency Decisions

Any decisions or approvals of the Mining Supervisor required by these Stipulations to be in writing may in emergencies be issued orally, with written confirmation as soon thereafter as possible.

D. Environmental Briefing

During the life of this Lease, Lessee shall provide that such Federal and State employees as may be designated by the Mining Supervisor shall brief employees of the Lessee on environmental and other pertinent matters. The Lessee shall provide for such briefings upon the request of the Mining Supervisor, but the Mining Supervisor shall request only such briefings as may be reasonably necessary to effectuate the provisions of this Lease. The Lessee shall make arrangements for the time, place, and attendance at such briefings. The Lessee shall bear all costs of such briefings other than salary, per diem, subsistence and travel costs of Federal and State employees.

E. Construction Standards

The general design of all buildings and structures shall comply with the latest edition of the Uniform Building Code (U.B.C.). Structural steel shall be designed in accordance with the latest edition of the American Institute of Steel Construction "Specifications for Design, Fabrication and Erection of structural Steel for Buildings." Reinforced concrete shall comply with the latest edition of the American Concrete Institute's "Building Code Requirements for Reinforced Concrete." Engineering works for impoundments shall conform to standard engineering practice sufficient to withstand the 100-year flood in the drainage in which installed.

SECTION 2
COLLECTION OF ENVIRONMENTAL DATA AND MONITORING PROGRAM

A. Purpose of Program

The Lessee shall compile data to determine the conditions existing prior

to any development operations under the Lease and shall, except as provided below, conduct a monitoring program before, during, and subsequent to development operations. The Lessee shall conduct the monitoring program to provide a record of changes from conditions existing prior to development operations, as established by the collection of baseline data, to provide a continuing check on compliance with the provisions of this Lease and all applicable Federal, State, and local environmental protection and pollution control requirements, to provide timely notice of detrimental effects and conditions requiring correction, and to provide a factual basis for revision or amendment of these Stipulations pursuant to Section 1(B) hereof. The environmental monitoring program shall be an integral part of the mining plan required under Section 11 of this Lease. Exploratory operations, in accordance with an approved exploration plan under Section 10 of this Lease, shall be permitted during the collection of the baseline data. All records of baseline data and subsequent monitoring required by this subsection shall be submitted to the Mining Supervisor at intervals to be prescribed by him.

B. Duration of Program

The baseline data shall be collected for a period of at least two consecutive full years, one full year of which shall be prior to the submission of the mining plan required under Section 11 of this Lease. At the time of the submission of that plan, the Lessee shall provide the Mining Supervisor with a record collected to date of the baseline data and the monitoring program. If the mining plan is submitted prior to the collection of the second year's data, the plan already submitted shall, at the discretion, or with the approval, of the Mining Supervisor, be modified as necessary as a result of study of the additional baseline data.

After the collection of the required baseline data for at least two years, the Lessee shall not be required to conduct a monitoring program on the Leased Lands until a date six months prior to the commencement of development operations. The monitoring program shall, thereafter, be conducted until the Mining Supervisor has determined to his satisfaction that environmental conditions have been established after the termination of development operations which are consistent with the requirements of applicable Federal and State statutes and regulations; however, the Mining Supervisor may terminate this requirement at an earlier date when it is in the public interest.

C. Methods for Conducting Program

In collecting baseline data and conducting a monitoring program the Lessee shall adopt the following methods, he shall collect the information required below and he shall maintain records of all the information obtained. Whenever the number and placing of testing installations are not given, they shall be as determined by the Lessee, but subject to being changed as required by the Mining Supervisor.

1. **Surface Water.** The Lessee shall construct gauging stations on the major drainages on the Leased Lands and, as required by the Mining Supervisor, upstream and downstream from the Leased Lands. Data collected at the stations shall include continuous streamflow records, continuous water temperature records, periodic analyses for selected inorganic and organic chemical constituents, as directed by the Mining Supervisor, continuous precipitation records, and continuous sediment records.
2. **Groundwater.** At such sites as the Mining Supervisor shall direct, the Lessee shall drill a test well, and he shall install an observation well in each water-bearing zone defined by the test well. The Lessee shall collect samples of drill cuttings and shall make boreholes geophysical logs as directed by the Mining Supervisor. The Lessee shall isolate each water-bearing zone penetrated by the test wells and pump each of the zones for the period required by the Mining Supervisor. During pump tests, the Lessee shall record the water-level fluctuations in each of the observation wells, maintain steady, continuous discharge from the test well, and record the discharge measurements. The Lessee shall maintain records of water level and temperature on each test well and on each observation well pursuant to a measurement schedule specified by the Mining Supervisor. At the initial pump test of each well the Lessee shall determine the water quality of that well by analyzing water samples for organic and inorganic chemical constituents, including, without limitation, trace constituents subject to drinking water standards and water pollution control regulations. The Mining Supervisor may require analysis of samples for such additional constituents as he may deem desirable. After the initial test, the Lessee shall collect water samples from each well at six-month intervals or closer intervals at the discretion of the Mining Supervisor and analyze each sample for evidence of trends in water quality as determined by comparing the samples with previous analyses.
3. **Air Quality.** In the collection of baseline data, the Lessee shall monitor air quality over at least 90 percent of each Lease year, during which monitoring is required, using such stations as the Mining Supervisor shall require. One of the stations shall be at the expected point of maximum concentrations, or as close to that expected point of maximum concentration as feasible.

   The Lessee shall monitor air quality using automatic instruments with continuous recorders, when applicable, where the Mining Supervisor has determined that such monitoring is necessary to determine baseline air quality or to conduct an effective monitoring program. In addition, the Lessee shall establish a meteorological station in reasonable proximity to any proposed plant site to monitor, at least 95 percent of the time over

each Lease year during which monitoring is required, wind direction and speed (vane and anemometer) and humidity at three levels, one at least 100 feet above the surface of the plant site, one at approximately 30 feet above the surface of the plant site, and one at ground level, and temperature at two levels, one at least 100 feet above the surface of the plant site, and one at approximately 30 feet above surface of the plant site.

4. **Flora and Fauna.** The Lessee shall make studies of the flora and fauna of the Leased Lands and of all other lands lying within a mile of the Leased Lands, unless otherwise directed by the Mining Supervisor, and also of the aquatic habitat as far downstream as the Mining Supervisor shall require. These studies will determine the distribution and density of the flora in these areas and periodically determine the condition of such flora. These studies shall also determine the species of fauna, the distribution, and their abundance at three-month intervals. The Lessee shall submit a report to the Mining Supervisor of the baseline data obtained and, during the monitoring program, shall submit semi-annual reports to the Mining Supervisor showing whether or not there has been any change. The Lessee shall also study, and report to the Mining Supervisor on ecological interrelationships including migratory patterns of birds, mammals, and fish, and plant animal relationships. The Lessee shall compile an inventory of natural surface water features, such as spring seeps.
5. **Soil Survey and Productivity Assessment.** The Lessee shall conduct a soil survey and productivity assessment of all portions of the Leased Lands proposed to be disturbed under the detailed development plan. This survey must include the preparation of maps, tables, and reports describing soil types, depth of the various layers of soil, to the depth intended to be disturbed but in no case less than 50 feet from the surface, strike and dip of the material, slopes, solar exposure, vegetative cover, and erodability.

D. Annual Report

Not more than one year after obtaining approval of the mining plan required under Section 11 of this Lease and on each subsequent Anniversary Date, the Lessee shall submit to the Mining Supervisor a report of the baseline data collected and a report of the monitoring programs as a part of the annual progress report required under Section 11 of this Lease. This portion of the annual report will be subject to public review and comment.

SECTION 3
ACCESS AND SERVICE PLANS

A. Transportation Corridor Plans

As part of the mining plan required under Section 11 of this Lease, the Lessee shall provide corridor plans for roads, pipelines and utilities on the Leased Lands for approval by the Mining Supervisor. Each plan shall include probable major design features and plans for the protection of the environment, prevention of pollution, minimization of erosion, and rehabilitation and revegetation of all disturbed areas not required in operation of the transportation system, both during and after construction. The Lessee shall, to the maximum extent practicable, make use of multi-use corridors for roads, pipelines and utilities.

B. Existing and Future Roads and Other Rights-of-Way

Where feasible, the Lessee shall use existing railroads, roads, trails, and other rights-of-way. Unless the Mining Supervisor shall direct otherwise, future railroads, roads, trails and other rights-of-way shall be located, constructed, maintained, and closed according to the specifications of the Bureau and shall include drainage structures where needed.

C. Regulation of Public Access

After road construction is completed, the Lessee shall, upon consultation with the Lessor, permit reasonable, free and unrestricted public access to and upon roads and rights-of-way for all lawful and proper purposes except to mine sites, disposal areas, operational haul roads, and other operational areas which may be closed to the general public. The Lessee shall regulate public access and public vehicular traffic as required to facilitate operations and to protect the public and, to the extent reasonable, livestock and wildlife from hazards associated with mining operations. For this purpose the Lessee shall provide warnings, flagmen, barricades, and other safety measures as necessary. Whenever the Mining Supervisor shall determine that the Lessee's regulation of access and traffic is unreasonable, or that the Lessee's provision of safety measures is inadequate, he shall so inform the Lessee who shall immediately take corrective measures.

D. Waterbars and Breaks

The Lessee shall divert runoff from roads and uphill slopes by means of waterbars, waterbreaks, or culverts constructed in accordance with the specifications of the Bureau.

E. Pipeline Construction Standards

In the design and construction of pipelines and the choice of materials for them, the Lessee shall follow the standards (wherever they may be made applicable) established by the Department of Transportation and, if these standards should ever be revised, supplemented, or superseded, shall follow the new standards in new construction. These standards include:

- 49 CFR 192, Transportation of Natural and Other Gas by Pipeline; and
- 49 CFR 195, Transmission of Liquids by Pipeline.

F. Pipeline Safety Standards

The Lessee shall meet, where applicable, the safety standards and reporting requirements set forth in the following, as now in effect and as

hereafter amended, or, if these regulations should be superseded, the regulations or other rules superseding them:

- 49 CFR, Part 110, Carriers by Pipeline (Other than Natural Gas and Water);
- 49 CFR 192, Transportation of Natural and other Gas and Water;
- 49 CFR, Part 195, Transmission of Liquids by Pipeline.

G. Shut-Off Valves

The Lessee shall insure that transportation pipeline designs provide for automatic shut-off valves at each pumping or compressor station and such additional valves as may be necessary in view of:

- Terrain and drainage systems traversed;
- Population centers;
- Wildlife and fishery habitat;
- Public water supplies and significant water bodies;
- Hazardous geologic areas; and
- Scenic Values.

The Lessee shall install any additional valves required by the Mining Supervisor.

H. Pipeline Corrosion

With regard to transportation pipelines, the Lessee shall submit to the Mining Supervisor, as part of the mining plan required by Section 11 of this Lease, detailed plans for corrosion-resistant design and methods for early detection of pipeline corrosion. These shall include: (1) pipe material and welding techniques to be used and information on their particular suitability for the environment involved; (2) details on the external pipe protection to be provided (coating, wrapping, etc.), including information on variation of the coating process to cope with variations in environmental factors; (3) plans for cathodic protection including details of impressed ground sources and controls to insure continuous maintenance of adequate protection over the entire surface of the pipe; (4) details of plans for monitoring cathodic protection current including spacing of current monitors; and (5) provision of periodic surveys of trouble spots, regular preventive maintenance surveys, regular surveys for external and internal deterioration which may result in failure, and special provisions for abnormal potential patterns resulting from crossings with other pipelines or cables.

I. Electric Transmission Facilities

The Lessee shall design and construct telegraph, telephone, electric powerlines, distribution lines and other transmission facilities in accordance with the guidelines set forth in "Environmental Criteria for Electric Transmission System" (U.S.D.I., U.S.D.A., 1970), as now or in the future amended, or if these guidelines should be superseded, in the guidelines or other rules superseding them. Distribution lines shall be designed and constructed in accordance with REA Bulletin 61-10 (Powerline Contacts by Eagles and other Birds), as now or in the future amended, or, if these guidelines should be superseded, in the guidelines or other rules superseding them. Nothing in this paragraph shall be deemed to require the reconstruction of facilities which at the time of their construction were in compliance with existing rules or guidelines.

J. Barriers

Where a railroad, road, trail, pipeline, transmission facility or exploratory site cuts a natural barrier used for livestock control, the Lessee shall, at his own expense, close the opening by the use of a fence or other suitable barrier meeting Bureau standards. All fences and cattleguards constructed by the Lessee shall meet established Bureau specifications and standards.

K. Crossings

The Lessee shall take all steps necessary to make certain that railroads, roads, trails, pipelines, and transmission facilities constructed under this Lease do not prevent or unreasonably disrupt the use of existing roads, trails, pipelines, and other rights-of-way or major animal migration routes. This requirement shall include the construction of suitable overhead or underground crossings where they are determined to be necessary by the Mining Supervisor.

L. Alternate Routes

If any of the Lessee's activities on the Leased Lands shall interfere with the free use of existing roads and trails used by persons, whether or not recorded, he shall provide such alternate roads and trails as the Mining Supervisor may determine to be needed.

M. Off-Road Vehicle Use

The Lessee shall use off-road vehicles in a manner consistent with applicable regulations.

SECTION 4 FIRE PREVENTION AND CONTROL

A. Instructions of the Mining Supervisor

1. The Lessee shall comply with the instructions and directions of the Mining Supervisor concerning the use, prevention and suppression of fires, and shall make every reasonable effort to prevent, control and suppress any fire on land subject to the Lease. Uncontrolled fires must be immediately reported to the Mining Supervisor.
2. a. The Lessee shall construct fire lines or perform clearing when determined by the Mining Supervisor to be necessary for forest, brush and grass fire prevention.
   b. The Lessee shall comply with the National Fire Codes on handling, transportation, storage, use and disposal of flammable liquids, gases, and solids.
   c. The Lessee shall take all appropriate actions to prevent coal outcrop fires.

B. Liability of Lessee

The control and suppression of any fires on the Leased Lands (or on adjoining public lands which have spread from the Leased Lands) caused by the Lessee or his employees, contractors, sub-contractors, or agents shall be at the expense of the Lessee. Upon the failure of the Lessee to control and suppress any such fires in a manner satisfactory to him, the Mining Supervisor shall take such steps as are necessary to control and suppress the fire, either alone or in conjunction with other Federal, State, and local authorities, and the cost of such

control and suppression shall be borne by the Lessee.

SECTION 5 FISH AND WILDLIFE

A. Management Plan

The Lessee shall submit to the Mining Supervisor, as part of the mining plan required under Section 11 of this Lease, a detailed fish and wildlife management plan which shall include the steps which the Lessee shall take to: (1) avoid or, where avoidance is impracticable, minimize damage to fish and wildlife habitat, including water supplies; (2) restore such habitat in the event it is unavoidably destroyed or damaged; (3) provide alternate habitats; and (4) provide controlled access to the public for the enjoyment of the wildlife resources on such lands as may be mutually agreed upon. The plan shall include, but not be limited to, detailed information on activities, time schedules, performance standards, proposed accomplishments, and ways and means of avoiding or minimizing environmental impacts on fish and wildlife.

B. Mitigation of Damage

Wherever destruction or significant disturbance of fish and wildlife habitat is inevitable, the Lessee shall submit, for the Mining Supervisor's approval at least 60 days prior to the destruction or damage of the habitat, those measures which the Lessee proposes to take to comply with the requirement of 30 CFR 231.4(b), as now in effect or as hereafter amended, or, if that regulation should be superseded, the regulations or other rules superseding it, to avoid, or, where avoidance is impracticable, minimize and repair, injury or destruction of fish and wildlife and their habitat. As a general rule, the proposed measures should provide for habitat of similar type and equal in quantity and quality to that destroyed or damaged. The Mining Supervisor shall, within 60 days after the submission of the proposed measures to him, either approve or disapprove them. If he shall approve them, the Lessee shall execute the proposed measures for the mitigation of the destruction or damage of the habitat. If the Mining Supervisor shall disapprove the measures, he shall offer the Lessee an opportunity for consultation at which, whenever possible, he shall inform the Lessee of any changes which will make the measures acceptable.

C. Big Game

The Lessee shall construct big game drift fences when and where necessary to direct big game movements around or away from operational areas.

D. Posting of Notices

The Lessee shall post in reasonable and conspicuous places notices informing its employees, agents, contractors, sub-contractors, and their employees of all applicable laws and regulations governing hunting, fishing, and trapping.

SECTION 6 HEALTH AND SAFETY

A. In General

The Lessee shall take all measures necessary to protect the health and safety of all persons affected by its activities and operations and shall immediately abate any activity or condition which threatens the life of any person or which threatens any person with bodily harm.

B. Housing and Welfare of Employees

In the exercise of his right under Section 2 of the Lease to construct buildings and other facilities for the welfare of his employees, the Lessee shall at all times make certain that these facilities are situated, constructed, operated, and maintained in an orderly manner, satisfactory to the Mining Supervisor. While no general restriction is imposed upon the construction of facilities necessary to the employees' health and well-being, such construction shall be subject to the Mining Supervisor's approval and shall not unreasonably damage the environment of the Leased Lands.

C. Compliance with Federal Health and Safety Laws and Regulations

The Lessee shall comply with the Federal Metal and Non-metallic Mine Safety Act of 1969 (30 U.S.C. §§ 721-740), as now in effect or as hereafter amended, or, if it should be superseded, with the statute superseding it, or, if applicable, the Occupational Health and Safety Act of 1970 (29 U.S.C. §§ 651-678), as now in effect, or as hereafter amended, or, if it should be superseded, with the statute superseding it, and all health and safety standards promulgated pursuant thereto.

D. Use of Explosives

The Lessee shall insure that all blasting operations, including the purchase, handling, transportation, storage, use, and destruction of blasting agents are performed in conformance with Public Law 91-452, October 15, 1970 (18 U.S.C. §§ 841-848), as now in effect or as hereafter amended, or if it should be superseded, with the statute superseding it, and the regulations promulgated thereunder which are now in 26 CFR 181.

SECTION 7 HAZARDOUS MATERIALS

A. Responsibility

If, during operations, any hazardous substance should be discharged, the control, removal, disposal, and cleanup of that substance, wherever found, shall be the responsibility of the Lessee. Upon the failure of the Lessee to control, remove, dispose of, or clean up the discharge, or to repair all damages resulting therefrom, the Mining Supervisor may take such measures as he deems necessary to control, remove, dispose of, or clean up the discharge and restore the area, including, where appropriate, the aquatic environment and fish and wildlife habitats, at the full expense of the Lessee. Such action by the Mining Supervisor shall not relieve Lessee of any responsibility as provided in this Lease.

B. Reporting of Spills and Discharges

The Lessee shall give immediate notice of any spills or discharges of hazardous substances to: (1) the Mining Supervisor and (2) such other Federal and State officials as are required by law to be given such notice. Any oral notice shall be confirmed by

the Lessee in writing as soon as possible.

C. Storage and Handling

The Lessee shall store oil, petroleum products, industrial chemicals and similar toxic or volatile materials in durable containers and locate such materials so that any accidental spillage will not drain into water courses, lakes, reservoirs, or ground water. Unless otherwise approved by the Mining Supervisor, the Lessee shall store substantial quantities (more than 500 gallons) of such materials in an area surrounded by impermeable containment structures. The volume of the containment structures shall be at least: (1) one-hundred-fifty (150) percent of the total storage volume of storage tanks in the relevant area; plus (2) a volume sufficient for maximum trapped precipitation and run-off which might be impounded at the time of a spill.

D. Pesticides and Herbicides

The Lessee shall not use pesticides and herbicides without the approval of the Mining Supervisor. Pesticides and herbicides shall be considered treatments of last resort, to be used only when reasonable alternatives are not available and where their use is consistent with protection and enhancement of the environment. Where pesticides and herbicides are used, they shall be used only with the approval of the Mining Supervisor and the type, amount, method of application, storage, and disposal shall be in accordance with applicable Federal and State procedures.

SECTION 8 POLLUTION – AIR

A. Air Quality

The Lessee shall utilize and operate all facilities and devices in such a way as to avoid, or, where avoidance is impracticable, minimize air pollution. At all times during construction and operation, Lessee shall conduct its activities in accordance with all applicable air quality standards and related plans of implementation adopted pursuant to the Clean Air Act, as amended (40 U.S.C. §§ 185-7185-71), as now in effect or as hereafter amended, or if it should be superseded, the statute superseding it, and applicable State standards.

B. Dust

The Lessee shall make every reasonable effort to avoid, or, where avoidance is impracticable, minimize dust problems. Where necessary, sprinkling, oiling, or other means of dust control shall be required on roads and trails, spoil piles, etc. The Lessee shall conduct processing operations so as not to create environmental or health problems associated with dust.

C. Burning

The Lessee shall not burn waste, timber, or debris, except when disposal is essential and other methods of disposal would be more harmful to the environment and when authorized by the Mining Supervisor.

SECTION 9 POLLUTION – WATER

A. Water Quality

The Lessee shall utilize and operate all facilities and devices in such a way as to avoid or, where avoidance is impracticable, minimize water pollution. At all times during construction and operation, Lessee shall conduct its activities in accordance with all applicable Federal and State water quality standards and related plans of implementation, as then in force. Where applicable Federal and State standards do not exist, the Mining Supervisor may establish reasonable standards to prevent degradation of water, and the Lessee shall comply with those standards. The Lessee shall not discharge waste water into any aquifer deemed by the Mining Supervisor to be a potentially valuable water supply nor into any aquifer which will discharge the waste into a surface stream.

B. Disturbance of Existing Waters

All activities, exclusive of actual mining activities, that may cause the creation of new lakes, drainage of existing ponds, diversion of natural drainages, alternation of stream hydraulics, disturbance of areas of stream beds or degradation of land and water quality or adversely affect the environmental integrity of the area are prohibited unless approved in writing by the Mining Supervisor.

C. Control of Waste Waters

In areas where overburden, water, or waste from mines or processing plants might contain toxic or saline materials, the Lessee shall:

- Divert surface or ground water so as to avoid the formation of toxic and saline water and its drainage into streams, or, where avoidance is impracticable, to minimize the formation of such waters and drainage, by preventing the entry or reducing the flow of water into the workings, waste piles, or overburden-storage areas;
- Contain any harmful ground water encountered in the mining operation;
- Dispose of refuse from mining and processing in a manner which will avoid the discharge of toxic drainage or saline water into surface or ground water;
- Employ, upon termination of operations or use of any mine, processing plant, or waste disposal site, all practicable closing measures consistent with ecological principles and safety requirements in order to avoid the formation and discharge of toxic or saline water;
- Dispose of toxic and saline water derived from mir ing or processing operations in a manner that does not pollute surface or ground waters;
- During mining operations, monitor spoil and refuse for the presence of materials likely to yield unacceptable alkaline, acidic, saline, or toxic solutes.

D. Cuts and Fills

The Lessee shall not cut or fill near or in streams which will result in siltation or accumulation of debris unless approved in writing by the Mining Supervisor.

E. Stream Crossings and Buffer Strips

The location of crossings of perennial streams, lakes control erosion,

the Lessee shall maintain buffer strips at least 200 feet wide on each side of a stream in their natural and undisturbed state unless otherwise authorized in writing by the Mining Supervisor.

F. Road Surfacing Material

All road surfacing material used by the Lessee must be approved by the Mining Supervisor.

SECTION 10 POLLUTION – NOISE

The Lessee shall comply with all applicable Federal and State standards on noise pollution, as now in effect or as hereafter amended, or, if they should be superseded, the standards superseding them. In the absence of specific noise pollution standards, the Lessee shall keep noise at or below levels safe and acceptable for humans, as determined by the Mining Supervisor.

SECTION 11 REHABILITATION

A. In General

The Lessee shall, in accordance with the mining plan, rehabilitate all affected lands to a usable and productive condition consistent with or equal to pre-existing land uses in the area and compatible with existing, adjacent undisturbed natural areas. Rehabilitation methods include, but are not limited to the following: leveling, backfilling, covering the surface with topsoil, and revegetating the spoil banks and areas consistent with sound restoration methods. The Lessee shall leave reclaimed land in a usable, nonhazardous condition such that soil erosion and water pollution are avoided or minimized. The Lessee shall, to the extent practicable, conduct such backfilling, leveling and grading concurrently with the mining operation. Upon removal of property at termination of the Lease operations. Upon removal of property at termination of the Lease pursuant to Section 29 of the Lease, the Lessee shall, in accordance with approved plans, complete the restoration of affected lands to a usable and productive condition at least equal to pre-existing land uses in the area and compatible with existing adjacent undisturbed natural areas.

B. Erosion Control and Surface Rehabilitation Plan

The Lessee shall submit for approval by the Mining Supervisor an erosion control and surface rehabilitation plan as part of the mining plan required under Section 11 of this Lease. The erosion control and surface rehabilitation plan shall be updated at least once every year. The plan shall include, but not be limited to, detailed information on activities, areas, time schedules, standards, accomplishments, and methods of eliminating or minimizing Coal development impacts. The Lessee shall base erosion control plans and procedures on a maximum 100-year precipitation rate characteristic of the area. If a 100-year rate is not available, the Lessee shall use data based on the longest period of reliable information. Procedures and plans shall consider flash flood effects, mud flows, mudslides, landslides, rock falls, and other similar types of material mass movements.

C. Flood Plains

The Lessee shall not construct improvements or conduct operations in flood plains or stream drainages when it is reasonable to expect risk to human life, pollution damage, or destruction of the existing environment caused by flood damage, without the express permission of the Mining Supervisor and without providing for protection of any such improvements constructed.

D. Areas of Unstable Soils

The Lessee shall, where possible, avoid areas having soils that are susceptible to slides and slips, excessive settlement, severe erosion and soil creep. When such areas cannot be avoided the Lessee shall conduct all operations in a manner which will insure maximum feasible stability. The Lessee shall make soil foundation investigations in conjunction with mining operations. The Lessee shall make such data available to the Mining Supervisor upon request.

E. Overburden

Overburden stockpiles shall be located so as to minimize damage to the surrounding lands.

1. **Topsoil.** In those areas to be surface mined, the Lessee shall strip the entire topsoil structure from all areas before excavation, and stockpile it for later reclamation of the area or, in accordance with this Section, place it on an available fill surface which has been graded to final form. The topsoil shall not be mixed or covered by subsurface materials. "Topsoil" is defined as the top horizon of overburden containing fertile soil or soil material, usually rich in organic matter and capable of sustaining plant growth and recognized as such by standard authorities.
2. **Subsoil.** In areas to be surface mined, the Lessee shall either stockpile the rock material for later reclamation of the area or, in accordance with this Section, place it on an available fill surface. "Subsoil" is defined as all overburden except topsoil.

F. Materials

The Lessee shall, when feasible, utilize waste rock from the mining operations for road beds, railroad beds, fills, and other similar construction purposes. When not feasible, gravel and other construction materials shall be purchased in accordance with 43 CFR 3610, as now in effect or as hereafter amended, or, if it shall be superseded, the regulation or rule superseding it, except that the sale of such materials from stream beds and upland soil areas shall be avoided unless otherwise approved by the Bureau District Manager.

G. Slopes of Cut and Fill Areas

To the extent consistent with good mining practice, the Lessee shall maintain all cut and fill slopes in a stable condition for the duration of the Lease.

H. Surface Disturbance On-Site

The Lessee shall correct surface disturbance which may include soil

movement or water pollution, or both, whether during or after mining operation. Areas where spoil piles and strip pits have been sloped steeper than a 2:1 slope during operations must be fenced for the safety of humans and animals.

I. Impoundments

The Lessee shall establish safe access to permanent water impoundments for persons, lifestock, and wildlife, but, where consumption of such water would be harmful to humans to the use of such water would be detrimental to animals, he shall take necessary steps to prevent access by those to whom it would be harmful or detrimental. When an excavation is to be left for the impoundment of water, the sides of the excavation shall be graded no steeper than a 3-1/2:1 slope so as to provide safe access to water for humans, livestock and wildlife.

J. Land Reclamation

In those areas which have been surface mined, unless the area is to be used for a permanent impoundment of water or unless otherwise directed by the Mining Supervisor, the Lessee shall return all mine wastes and overburden to the excavation. Final grading shall be performed so that side slopes are no greater than 3-1/2:1. Topsoil shall be distributed over the entire disturbed area to a uniform depth. The fill materials immediately underlying the topsoil shall not be of a subsurface material detrimental to the establishment of vegetation. The objective shall be an even or gently undulating skyline that conforms to the surrounding terrain and a stable surface which is susceptible to vegetation. Backfilling of excavations, sloping and grading of spoil piles, covering with topsoil and initial revegetation of each segment of disturbed area shall be completed in accordance with the erosion control and rehabilitation plan and as soon as the segment is no longer needed for mining, but such rehabilitation shall be completed not later than one year after completion of mining in that segment unless an alternative schedule has been approved by the Mining Supervisor.

K. Revegetation

1. The Lessee shall revegetate all portions of the Leased Lands which have been disturbed by his operations as soon as possible after the disturbance has ended and the grading of the topsoil is completed in order to prevent, or, if prevention is impracticable, to minimize erosion and related problems. The Lessee shall restore the vegetation of disturbed areas in accordance with the erosion control and surface rehabilitation plan by reestablishing permanent vegetation of a quality which will support fauna of the same kinds and in the same numbers as those existing at the time the base line data was obtained under Section 1(C) of these Stipulations. However, if the Lessor determines, at the time of submission of the erosion control and surface rehabilitation plan, that the Leased Lands will, upon the termination of the Lease, be put to a different use from that to which they were devoted immediately prior to the issuance of this Lease, the Mining Supervisor may require the Lessee to revegetate the land to meet that objective, except that the Lessee shall not be required to expend more money than that needed to meet the first revegetation standard.
2. The Lessee shall demonstrate at the time of submission of the erosion control and surface rehabilitation plan under that revegetation technology is available to enable him to provide the revegetation of the disturbed areas which is required under paragraph (1) of this subsection.
3. All disturbed areas shall be seeded with a drill between April 1 and May 31 or between September 1 and October 30. All seeds sown must be tested and meet standards for purity and germination as established for the area, and the cost of seed testing will be borne by the lessee.
4. The Mining Supervisor may require any other reasonable method of revegetation. He may require the Lessee to fence areas in order to assist revegetation, or, where sprinkling is necessary to obtain suitable revegetation, he may require the installation and use of a sprinkling system.

L. Stabilization of Disturbed Areas

The Lessee shall leave all disturbed areas in a stabilized condition. Stabilization practices shall include, as determined by the needs of specific sites: seeding; planting; mulching; and the placement of mat binders, soil binders, rock or gravel blankets or other such structures. Seeding and planting shall be repeated, as often as the Mining Supervisor shall deem reasonable, if prior attempts to revegetate are unsuccessful. All trees, snags, stumps or other vegetative material, not having commercial, ecological, wildlife, or construction value, shall be considered for mechanical chipping and spreading in a manner that will aid seeding establishment and soil stabilization.

SECTION 12 VEGETATION

A. In General

1. The Lessee shall reserve from cutting and removal all timber and other vegetative material outside the clearing boundaries and all blazed, painted or posted trees which are on or mark the clearing boundaries, with the exception of danger trees or snags designated as such by the Mining Supervisor.
2. The Lessee shall insure that all trees, snags or other woody material cut in connection with clearing operations are felled into the area being cleared and away from live water courses.

B. Timber

The Lessee shall deal with timber in accordance with the following: clearing and grubbing limits shall be approximately 5 feet outside of the edge of any cut or fill; where practicable, trees, snags, stumps or other woody material not having wildlife value or value to the Lessee shall be mechanically chipped and spread in a manner

that will aid seeding establishment and soil stabilization; clearing boundaries shall be identified on the ground prior to clearing operations.

C. Clearing and Stripping

The Lessee may clear and strip only such land as is necessary for mining, processing, and other operations under the Lease. In connection with such operations the Lessee may clear and strip land necessary for roadbeds, but such roadbed widths shall be not more than 25 feet from the centerline unless otherwise specified by the Mining Supervisor.

SECTION 13 ANTIQUITIES AND OBJECTS OF HISTORIC AND SCIENTIFIC VALUE

A. The Lessee shall engage a qualified professional archeologist, historian, or paleontologist, acceptable to the Authorized Officer, to conduct a thorough and complete intensive survey, in advance of surface disturbing activities, for evidence of antiquities or other significant values of historic or scientific interest including, but not limited to, historic or prehistoric ruins, or artifacts, and shall avoid disturbance of or salvage such values when determined to be necessary by the Mining Supervisor. The responsibility and cost of such survey and salvage will be that of the Lessee. Such work as required by this stipulation shall be undertaken under the authority of a current Antiquities Act permit, applicable to the area to be investigated.

B. The Lessee shall immediately bring to the attention of the Mining Supervisor any objects or values of historic or scientific interest, as identified in subparagraph (a) above, discovered as a result of operations under this Lease, and shall leave such discoveries intact. The Mining Supervisor will evaluate the discoveries brought to his attention, and will determine, within 5 working days, what action will be taken with respect to such discoveries. In addition, in the event unusual fossil(s) or Mineral specimen(s) are discovered, the Lessee will, in order to facilitate their evaluation, report the discovery to the National Museum of Natural History, Department of Mineral Sciences or Department of Paleobiology, Smithsonian Institution, Washington, D.C., in conjunction with or through the Mining Supervisor. Where a report (oral or written) has been submitted to the Smithsonian Institution, the Mining Supervisor may postpone his decision as to the action to be taken for two additional working days in order to give the Smithsonian Institution an opportunity to submit its comments and recommendations. The responsibility for and cost of investigations and salvage of such values found during operations will be that of the government.

SECTION 14 SCENIC VALUES

A. Scenic Considerations in General

The Lessee shall, except where the Mining Supervisor has approved otherwise, use the following standards in all designing, clearing, earthmoving, and construction:

- Contours compatible with the natural environment shall be used to avoid straight lines.
- Natural colors consistent with the local environment such as pastels or muted shades of brown, green, reds, or greys shall be used in painting of facilities installed on the Leased Lands. Bright or unnatural colors shall be avoided except for use in warning signs or signals.
- Small natural openings or the edges of larger openings in the natural environment shall be utilized in the construction of facilities, or disturbing the land surface.
- During the time when the land is disturbed, the portion of land which is not under revegetation programs shall only be those areas required under the mining plan for mining, storage, or processing operations.
- Contouring of the disturbed areas for reclamation shall simulate natural openings or areas consistent with the surrounding topography.

B. Consideration of Aesthetic Values

The Lessee shall consider existing aesthetic values in all planning, construction, reclamation and mining operations. All roads, railroads, pipelines and transmission lines, shall, where practicable, be performed so as to minimize visual impact, make use of the natural topography, and to achieve harmony with the landscape.

C. Protection of Landscape

The Lessee shall design any structures and facilities built under this Lease so that they will, to the extent practicable, blend with the natural landscape.

D. Signs

The Lessee shall design and construct signs that are rustic in appearance and conform to the sign standards of the Bureau of Land Management.

SECTION 15 WASTE DISPOSAL

A. Mine Waste

The Lessee shall, in accordance with the detailed development plan, backfill or reclaim excavated material and shall compact it thoroughly by machinery to avoid erosion. The Lessee shall design slope faces of waste piles so that the slope is stable and not greater than 3-1/2:1, and he shall revegetate slope faces in accordance with the rehabilitation plan.

B. Other Disposal Areas

The term "waste" as used in this subsection (B) means all waste other than mine waste. In accordance with approved plans, the Lessee shall recycle waste or he shall dispose of waste in sanitary land fills or other disposal areas, and he shall use the best practicable portable or permanent waste disposal systems, as approved by the Mining Supervisor. The Lessee shall remove or otherwise dispose of all waste in a manner acceptable to the Mining Supervisor, and in accordance with all applicable standards and guidelines of the State, the United States Public Health Service and the Environmental Protection Agency.

C. Disposal of Solid and Liquid Wastes

The Lessee shall design and construct disposal systems for solid and liquid wastes so as to avoid landslides, control erosion by wind and water, and establish conditions conducive to vegetative growth in the disposal area. The Lessee shall select and prepare disposal sites for wastes so as to avoid downward percolation of leached products and other pollutants into aquifers.

D. Impoundment of Water

No disposal of mine waste, other waste, or the residue from any activity under this lease shall be disposed of in a manner which could cause an impoundment of water unless plans for spillways and means of diversion and the prevention of both surface and underground water contamination have been prepared by the Lessee and approved by the Mining Supervisor, and the Lessee has complied with those plans.

E. Slurry Waste Disposal

Wherever slurry waste disposal is used the Lessee shall provide impoundments sufficient to contain landslides, mud flows, or waste pile blowouts.

Appendix F
Protective Stipulations From BLM Manual 3509, November 9, 1970

1. Activities employing wheeled or tracked vehicles shall be conducted in accordance with industry practices and in such a manner as to minimize surface damage.
2. Trail widths shall be kept to the minimum necessary and may not exceed   feet. Surface may be cleared of timber, stumps, and snags. Care must be taken to avoid scarring or removal of ground vegetative cover.
3. Drainage systems shall not be blocked. No cuts or fills shall be made near or in streams which will result in siltation or accumulation of debris. All damage to streams must be repaired to the satisfaction of the authorized officer.
4. All operations must be conducted so as not to change the character or cause pollution of streams, lakes, ponds, waterholes, seeps, and marshes or cause damage to fish and wildlife resources.
5. Surface damage which causes soil movement and/or water pollution must be corrected to the satisfaction of the authorized officer.
6. Vegetation must not be disturbed within 300 feet of any waters designated in a (prospecting permit), (lease), or (contract), except at authorized stream crossings.
7. No explosives may be used without written consent of the authorized officer.
8. Trails and campsites must be kept clean. All garbage and foreign debris must be eliminated by removal or burial. Burning is permissible only by prior written consent of the authorized officer.
9. Existing roads and trails shall be used whenever possible.
10. All survey monuments, witness corners, reference monuments, and bearing trees must be protected against destruction, obliteration, or damage. Any damaged or obliterated markers must be reestablished in accordance with accepted survey practices at the expense of (permittee), (contractor), or (lessee).
11. The operator shall make every effort to prevent, control, or suppress any fire in the operating area. Reports of uncontrolled fires must be immediately sent to the authorized officer or his representative.
12. Fill all holes, pits, and excavations to the extent agreed in the approved mining plan and grade to the natural contour.
13. When surface operations are conducted, overburden or other waste shall be returned to the excavation, as set forth in the mining plan and except in instances when the district manager or state director determines that it would be desirable to use an excavation for the permanent impoundment of water or for other beneficial uses.
14. Disposal sites shall be selected and prepared so as to avoid downward percolation of pollutants into aquifers.
15. Disposal systems for solid and liquid wastes shall be designed and constructed so as to avoid landslides, control wind and water erosion, and establish conditions conductive to vegetative growth in the disposal area.
16. Casual accumulations of water on waste piles shall be avoided, and where necessary, surface waters shall be directed around the piles.
17. Final grading of backfilled and other unconsolidated materials shall be so performed as to prevent a surface susceptible to vegetation or desired land form.
18. Excavations used for the permanent impoundment of water shall be graded to establish safe access to water for persons, livestock, and wildlife.
19. No solid rock face or bench face shall exceed   feet in height. Appropriate access suitable for persons, livestock, and wildlife shall be provided for every   feet of continuous rock or bench face.
20. Except for solid rock faces, bench faces, and excavations used for impoundment of water, those surface areas of the leased premises disturbed by operations conducted by the lessee shall be revegetated when their use is no longer required by the operator. (Species, methods, and season of seeding or planting, etc., should be specified. These requirements should be practical and generally should not require vegetative rehabilitation beyond level of production.)
21. Backfilling, final grading, and vegetation shall be completed within two years after the completion or termination of the particular operation involved unless the district manager extends the time.
22. Drill holes shall be permanently sealed or filled as directed by the

district manager upon completion of operations.

23. Surface buildings, supporting facilities, and other structures which are not required for particular operations shall be removed and the area graded and revegetated.

24. All operations shall be conducted with a view to avoidance of range and forest fires and spontaneous combustion. Open burning of carbonaceous materials shall be in accordance with suitable practices for fire prevention and control.

25. The lease or contract premises shall be appropriately posted and fenced or otherwise protected to minimize injury to persons, livestock, and wildlife.

26. All access, haul, and other support roads and trails shall be constructed and maintained in such a manner as to control and minimize channeling and other erosion. Roads and trails shall be constructed only at locations approved by the authorized officer

27. All roads constructed in the operation shall be closed by barricades or protected from erosion by placing of water control bars as required by the district manager

28. All existing improvements including, but not limited to, fences, gates, cattle guards, roads, trails, culverts, water development and control structures, shall be maintained in serviceable condition. Damaged or destroyed improvements shall be replaced, restored, or appropriately compensated for.

29. When agreed by lessee and lessor, the lease site shall be available for other public uses including, but not limited to, livestock, grazing, hunting, fishing, camping, hiking, and picnicking.

30. Topsoil shall be removed and stockpiled prior to removal of overburden. Stockpiles shall be located so as not to be covered by spoil materials and to facilitate their use in final backfilling and grading.

Appendix G
USFS
Coal Leasing Stipulations

DEPARTMENT OF AGRICULTURE

Applicable to Exploration Activities

1. At least two weeks before beginning any exploration work, including access and work road location and construction, the lessee shall prepare a "Lessee Exploration Plan" with the District Ranger, and the Branch of Mining, Conservation Division, U.S. Geologic Survey. The plan shall be prepared in triplicate, including maps, for approval by the Forest Supervisor. Such approval will be conditioned on reasonable requirements needed to prevent soil erosion, water pollution, and unnecessary damages to the surface vegetation and other resources of the United States and to provide for the restoration of the land surface and vegetation. The plan shall contain all such provisions as the Forest Service may deem necessary to maintain proper management of the lands and resources within the exploration area. Where appropriate, depending upon the location and type of operation, the Forest Supervisor may require the plan to contain, at a minimum, the following items:
   a. The location, construction specifications, maintenance program, and estimated use by the lessee, his employees and agents, of all access and work roads.
   b. The location and extent of any and all areas to be occupied during the explorations.
   c. The methods to be used in the explorations, including disposal of waste material.
   d. The size and type of equipment to be used in the explorations.
   e. The capacity, size, character, standards of construction and location of all structures and facilities to be constructed.
   f. Typical profiles of cuts and fills of all areas to be graded for the installation of structures and facilities.
   g. The location and size of areas upon which vegetation will be destroyed and/or soil laid bare and the steps which will be taken to prevent and control soil erosion thereon, including, but not limited to, the proposed program for rehabilitation and revegetation of these disturbed lands both during and upon cessation of explorations.
   h. The steps which will be taken to prevent water pollution.
   i. The character, amount, and time of use of explosives or fire, including safety precautions which will be taken during their use.
   j. The coordination and rehabilitation measures that will be taken to protect other uses of the land, permitted livestock, and wildlife.

   If later explorations require departures from or additions to the approved plan, these revisions or amendments, together with justification statement for proposed revisions, will be submitted to the District Ranger for approval of the Forest Supervisor. Any and all operations conducted in advance of approval of an original, revised, or amended exploration plan, or which are not in accord with an approved plan, constitutes a violation of the terms of this lease and the Forest Service reserves the right to close down explorations until such corrective action, as is deemed necessary, is taken by the lessee.

2. To guarantee the successful rehabilitation and revegetation of abandoned exploration sites, roads and other disturbed areas, as provided for in the "Lessee Exploration Plan" (paragraph 1) above, the lessee will furnish the Forest Service a surety bond in the amount of $ prior to undertaking any work on the lease area. Provided that, in the event the work is conducted in separate phases, each phase will be covered by a separate bond in the minimum amount of $, before the start of any work on each phase. In lieu of surety bond, the lessee may deposit into a Federal Depository cash, through the Unit Collector Officer, National Forest, or negotiable securities through the Regional Fiscal Agent, U.S. Forest Service, Building 85, Denver Federal Center, Denver, Colorado, 80225, in the amounts stated above or each separately bonded phase area. As soon as the lease area has been successfully rehabilitated and revegetated and approved in writing by the Forest Supervisor, surety will be notified, or cash deposits returned without interest, or securities returned without interest. The lessee agrees that all monies or deposits in lieu thereof, deposited under this authority may be retained by the

United States to cover the cost of any said restoration and rehabilitation rendered necessary by failure of the lessee to fulfill all and singular the requirements assumed hereunder without prejudice whatever to any rights and remedies of the United States.

3. No occupancy of the surface of the following areas is authorized by this lease. The lessee is, however, authorized to employ directional drilling to explore the mineral resources under these areas provided that such drilling or other works will not disturb the surface area or otherwise interfere with their use by the Forest Service. It is understood and agreed that the use of these areas for National Forest purposes is superior to any other use. The excluded areas are:
   a. Within the normal highwater line of any and all lakes, ponds, and reservoirs located within the lease area.
   b. Within 200 feet of the normal highwater line of any and all live streams in the lease area.
   c. Within 400 feet of any and all springs and wells within the lease area.
   d. Within 400 feet of any improvements either owned, permitted, leased, or otherwise authorized by the Forest Service.

   The distances in subparagraphs a, b, c, and d, may be reduced when specifically agreed to in the exploration plan (paragraph 1).

Applicable to Production (Operation) Activities

1. The lessee, before the start of any mining operations, agrees to enter into such additional specific stipulations with the Forest Service covering the lessee's mining operations as are deemed necessary and appropriate, depending upon the mining methods to be used and current mining and restoration technology, to meet the following land management primciples:
   a. Maintain and protect the areas which will be either directly or indirectly affected by the lessee's mining operations to minimize the effect on grazing capabilities.
   b. Install structures and facilities and revegetate disturbed areas to protect the soil from excessive erosion and return the land to a usable condition.
   c. Take all measures reasonably necessary to minimize the pollution and contamination of the surface and subsurface water sources.
   d. Protect, insofar as is practicable, and restore or replace these said improvements in event they must be destroyed or disturbed by the lessee's mining operations. Such stipulations will be developed jointly by the lessee; representatives of the Branch of Mining Operations, Conservation Division, U.S. Geological Survey; and the Supervisor, Forest Service.
2. The lessee shall prepare in triplicate and submit an annual operating plan to the Forest Service which will include as a minimum:
   a. The mining operating areas and the methods of operation planned for each area.
   b. The areas to be treated and details of the rehabilitation and revegetation measures to be initiated in the planning year to meet the stipulated requirements of the Forest Service.
   c. The location and construction specifications of all roads necessary for the mining operation during the planning year.
   d. The steps to be taken to minimize water pollution and soil erosion.
   e. The correlation of the mining operation with the Forest Service's use and management of the lands not included in that year's operating plan.
3. The lessee shall submit to the Forest Supervisor an annual progress map and report of mining, restoration, and revegetation operations.
4. The lessee shall furnish performance bonds as required by the Forest Supervisor to guarantee fulfillment of the stipulations, entered under (1) above, and the operating plans, prepared under (2) above.
5. The Forest Service reserves the right to amend, alter, or otherwise change during the life of the lease, any and all stipulations necessary to meet the land management principles outlined in paragraph 1 above provided that before any such amendments, alterations, and other changes are made, the lessee shall be invited to make any comments as he may deem necessary and, provided further, that no such amendments, alterations, and changes in these stipulations shall be made unless agreed to in writing by the lessee and the Forest Service.
6. The Forest Service reserves the right to manage and use all lands administered by it which are embraced within the lease for such purposes as they may deem desirable, provided, that this use and management shall not interfere or conflict with the current mining operations of the lease.